

Science, Technology, Automotive, Home, and Adventure

ULTRABOOKS
A BUYER'S GUIDE TO
YOUR NEXT PC **P. 84**

**GREAT GEAR
& GADGETS**
UPGRADE NOW! **P. 25**

BOSS 302!
CROSS-COUNTRY IN THE
HOT NEW MUSTANG **P. 92**

**20 GAS
SAVING
TIPS**

P. 124

POPULARMECHANICS.COM
VOLUME 189, NO. 7

07.12

Popular Mechanics

EXCLUSIVE ACCESS

THE FUTURE OF

SPECIAL OPS

**NEW TECH, TACTICS,
AND MISSIONS**

**POPMECH GOES INTO
LIVE-FIRE TRAINING
WITH THE WORLD'S
MOST ELITE
WARRIORS **P. 76****

- **HOW TO SPEND
LESS TIME
(AND CASH)
ON YARDWORK
P. 104**
- **PROJECT FOR
KIDS: BUILD
A BOOMBOX
P. 138**
- **DODGING
SNAKES &
ALLIGATORS
IN A SWAMP
BUGGY
P. 54**





© 2011 FRAM Group IP LLC.

Get more motor out of your motor.

Move up to Autolite® Xtreme Sport® spark plugs. From motorcycles to motorboats, Xtreme Sport® plugs start all forms of powersports motors up to 26% faster than standard spark plugs and help keep them running at peak performance even in the most extreme conditions. Learn about Xtreme Sport® and all Autolite performance parts at autolite.com.

MOVE UP >>
Autolite
XTREME SPORT®





Get more motor out of your motor.

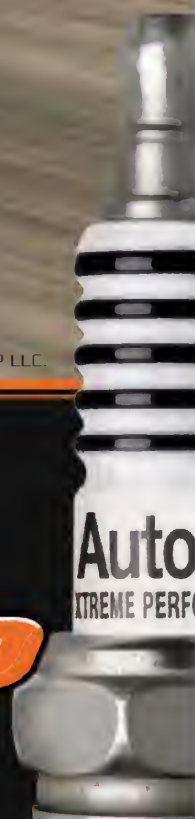
Move up from your old OE plugs to Autolite® XP Xtreme Performance® plugs. Made for any vehicle, import or domestic – they enhance performance, help maintain peak fuel efficiency, and last up to 100,000 miles with a five-year limited guarantee. To learn about XP and all Autolite parts, visit autolite.com.



©2012 FRAM Group IP LLC.

MOVE UP >>
Autolite XP

Auto
XTREME PERFO



07.12

Popular Mechanics

IGNITION

Writer Sam Smith gives the 2012 Ford Mustang Boss 302's V-8 a break outside a motel in North Platte, Neb.

92

INSIDE

IGNITION

Letters, Complaints, Events 04

TECH WATCH

News, Trends, Breakthroughs .. 13

UPGRADE

Gear, Tools, Gadgets 25

AUTO INTEL

Test Drives, Car Tech, Hot Rides 36

COLUMNS**I'll Try Anything:**

Swamp Bugging 54

FEATURES

Looking Downrange PM trains with U.S. Special Ops forces as they prepare for the drawdown in Afghanistan—and missions beyond.
BY JOE PAPPALARDO 76

So You Want to Buy an Ultrabook It's light, powerful—and might well be your next PC.

BY GLENN DERENE AND ANTHONY VERDUCCI 84

Welcome to the New Solar

Maximum As our dependence on technology grows, so does the threat of solar storms.

BY LEE BILLINGS 86

Freedom of the Road Driving cross-country in a Mustang Boss 302, a father and son explore America's auto-racing history.

BY SAM SMITH 92

ON THE COVER

Bringing Special Operations forces to our cover shoot at Brooklyn's Fast Ashleys Studios proved troublesome, so we improvised. To help model Tim Ryan portray one of America's elite warriors, we armed him with an M4 carbine outfitted with a SOPMOD accessory kit—the same gear used by the 1st Special Forces Group in this month's cover story. Photographer Monte Isom nailed the shot.



They don't just give you this one, pal.

YOU G EARN

Motor Trend's
2012 Truck of the Year.®



GOTTA IT.



Powerful. Capable. Fuel-efficient.*

This is the future of truck
THE 2012 F-150

FORD.COM



*3.5L EcoBoost® 4x2. EPA-estimated 16 city/22 hwy/18 combined mpg.

PopularMechanics

New!

W
weekend

23 Pages of DIY

20
WAYS
TO SAVE
GAS
P. 124

IGNITION

TALK TO US

CURATED BY
ALYSON SHEPPARD

What You Said

(ABOUT OUR MAY ISSUE AND MORE)

We read all of your comments, tweets, and letters to PM—even the ones written on light bulbs. Keep 'em coming!

✉ email popularmechanics@hearst.com
 ✉ mail 300 West 57th Street, New York, NY 10019
 📧 subscribe subscribe.popularmechanics.com

Our May issue inspired many insightful letters. ● Responding to our cover story, "Reengineering the Human," which predicted the obsolescence of prostheses in the next 40 years, Andy Prevelig of Tallahassee, Fla., had another idea: "Instead of trashing all of the mechanical and software creations in 2050, we should use them to make helper androids," he wrote. ● Arthur L. Cunningham of Delafield, Wis., appreciated our story on esoteric auto repair, "Brotherhood of the Wrench." "What a well-written article," he said. "There are many disparate West Coast niche restoration shops that enthusiasts should take the time to check out." ● "What Went Wrong: Cruise Ship Disaster" examined the *Costa Concordia* shipwreck.

Ten-year-old Christopher Poy of Millburn, N.J., reads PM so he can help his dad with DIY projects around the house. "You're the most interesting and useful magazine ever!" he writes.



104. Home

Pick the right landscape plan to fit your style and budget.
Home Clinic Replacing handles on old tools.

118. Science

How to watch—and count—fireflies to help researchers gather crucial data.

120. Auto

Real gearheads use air tools. We get you started on the path to pneumatic bliss.
Tactics 20 Ways to Save Gas
Car Clinic Oil for Any Season

131. Adventure

The canoe-paddling method you learned at camp is wrong. Here's the right way.

134. Tech

How to edit your home movies and give them the polished look they deserve.
Early Adopter Build a boombox.
Digital Clinic Power Sharing

?#@*%!

COMPLAINTS DEPARTMENT

"Get Real.

Calling the Vespa GTS 300 Super a 'Prius beater' is absurd ("Six-Scooters," April). Can we please compare apples to apples, not apples to nuclear subs? The Vespa seats two to the Prius's five, and gets you wet when it rains."
 — Bruce Johnson, Madison, WI

GREAT SOUND
COMES NATURALLY.



create wonder



By combining analog vacuum tubes with digital technology you'll enjoy music and entertainment the way they were meant to be heard. The Samsung HT-E6730W Home Entertainment System comes with everything you need to fill your home with warm, natural, truly lifelike audio. Plus, the included Blu-ray™ player gives you access to the internet, apps and a world of smart content. Experience the future of home entertainment at samsung.com/hometheater.

SAMSUNG

"I'm glad the cruise-ship industry requires lifeboat evacuation drills before departing port," wrote David Gross of Tiffin, Ohio. "Ships should consider livening up presentations with onboard entertainers. Safety is a serious topic, but the audience needs to stay attentive." ● "I was surprised to see a picture of a Yankee screwdriver in DIY: Home (Yankee Dandy)," Bob Moore of Ontario wrote. "In Canada, Yan-

kee screwdriver is our name for a hammer!" (Sorry, Bob, but we won't be provoked into cracking wise about Canadians.) ● To the fan mail: "@PopMech has to be one of the best, if not *the* best, digital magazines in the iTunes Store!" Brad Chambers (@bradwchambers) tweeted. Bill Peterson (@thebillp) wrote: "I always travel with a copy of @PopMech. I consider this magazine my friend." Thanks, pal.

● App-tastic! PM's Used Car Checklist

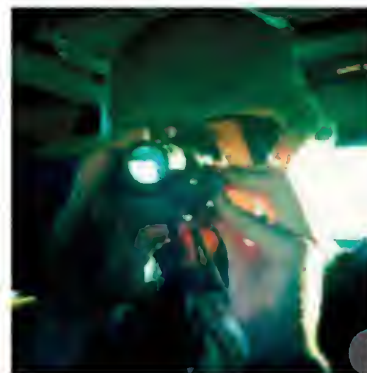
Looking for a new (but experienced) ride? The "Popular Mechanics Used Car Checklist" just hit the iTunes Store. Written by our auto editors, the free app walks you through a 101-point inspection to help you get a good deal and avoid buying a clunker.

WHAT YOU SAID

IGNITION

What We're Up To

(PM NEWS & EVENTS & STAFFERS ON THE SCENE)



(a) Special projects editor Joe Bargmann tests out the Scion FR-S in Red Rock Canyon National Conservation Area near Las Vegas.

(b) Senior news editor Joe Pappalardo peers through a night-vision monocular during a ride-along in a Special Operations forces' mine-resistant ambush-protected vehicle. Pappalardo reported from the Army's Yakima [Wash.] Training Center for our cover story, "Looking Downrange."

(c) Associate editor Erin McCarthy preps our homemade T-shirt cannon for blastoff at the USA Science & Engineering Festival in Washington, D.C.

a DRIVING THE SCION FR-S IN NEVADA



We're
really
busy in
July

JULY 1: Volvo Adventure Competition opens
JULY 4: Grilling and watching fireworks (that counts!)
JULY 23: Google Science Fair, Mountain View, Calif.
JULY 27: Opening of the 2012 Summer Olympics, London
JULY 28-29: Maker Faire Detroit, Dearborn, Mich.



©2012 Bombardier Recreational Products Inc. (BRP). All rights reserved. TM and the BRP logo are trademarks of BRP and its affiliates. All other marks are trademarks of their respective owners. Use responsibly and safely and observe applicable laws and regulations.

FEEL A DEEP CONNECTION WITH THE ROAD. THREE OF THEM TO BE EXACT.

The Can-Am® Spyder® roadster. Its unique, three-wheeled stance delivers exhilarating, confident handling. Automotive technologies like anti-lock braking, a vehicle stability system and a paddle-shifting, semi-automatic transmission keep you feeling at one with the road. It's riding. Reinvented. Learn more at can-am.brp.com

can-am.



SEE IT IN ACTION



PopularMechanics

JAMES B. MEIGS

EDITOR-IN-CHIEF; EDITORIAL DIRECTOR,
MEN'S ENTHUSIAST GROUP

EXECUTIVE EDITOR **David Dunbar**
DESIGN DIRECTOR **Michael Lawton**
DEPUTY EDITOR **Jerry Beilinson**
MANAGING EDITOR **Michael S. Cain**

Editorial

EDITOR, AUTOMOTIVE **Larry Webster**
SENIOR EDITOR, HOME **Roy Berendsohn**
SENIOR EDITOR, SCIENCE **Jennifer Bogo**
SENIOR EDITOR, TECHNOLOGY **Glenn Derene**
SENIOR EDITOR, NEWS **Joe Pappalardo**
ASSOCIATE EDITOR **Erin McCarthy**
ASSOCIATE EDITOR, AUTOMOTIVE **Ben Woldyla**
ASSISTANT EDITOR **Andrew Del-Colle**
COPY CHIEF **Robin Tribble**
RESEARCH DIRECTOR **David Cohen**
ASSISTANT RESEARCH EDITOR **Alyson Sheppard**
ASSISTANT TO THE EDITOR-IN-CHIEF **Theresa Breen**
WEST COAST EDITOR **Ben Stewart**
SPECIAL PROJECTS EDITOR **Joe Bargmann**

Art

SENIOR ART DIRECTOR **Peter Herbert**
ASSOCIATE ART DIRECTORS **Mike Ley, R. Scott Wells**
INTERACTIVE DESIGNER/ILLUSTRATOR
Anthony Verducci

Photography

DIRECTOR OF PHOTOGRAPHY **Allyson Torrisi**
SENIOR ASSOCIATE PHOTO EDITOR **Michele Ervin**

Editorial Board of Advisers

Buzz Aldrin (APOLLO 11 ASTRONAUT)
Shawn Carlson (SOCIETY FOR AMATEUR SCIENTISTS)
David E. Cole (CENTER FOR AUTOMOTIVE RESEARCH)
Saul Griffith (OTHERLAB)
Thomas D. Jones (NASA ASTRONAUT)
Dr. Ken Kamler (MICROSURGEON)
Gavin A. Schmidt (NASA GODOARO INSTITUTE
FOR SPACE STUDIES)
Amy B. Smith (MIT)
Daniel H. Wilson (ROBOTICIST)
Wm. A. Wulf (NATIONAL ACADEMY OF ENGINEERING)

Senior Correspondents

Davin Coburn, Alex Hutchinson, Erik Sofge,
Logan Ward, Jeff Wise
PYROTECHNICS & BALLISTICS EDITOR
William Gurstelle
MYTHBUSTING EDITORS
Jamie Hyneman, Adam Savage
GARAGE PROPRIETOR **Jay Leno**
RESIDENT CONTRARIAN **Glenn Harlan Reynolds**

Production

ASSISTANT MANAGING EDITOR **Natalie Neusch**
DIGITAL ASSETS EDITOR **Ed Manning**

Imaging

DIGITAL IMAGING SPECIALIST **Steve Fusco**

PopularMechanics.com

ONLINE DIRECTOR **Angela Diegel**
ONLINE EDITOR **Andrew Moseman**
ONLINE PRODUCER **Carl Davis**

PopularMechanics Interactive

ART DIRECTOR, MOBILE PLATFORMS **John Walker**
TECHNICAL LEAD **Jeremy Berman**
DEVELOPERS **Alexander Karpodinis, Johnny Tablada**
PRODUCERS **Spencer Lloyd, Jeff Zinn**

Contributing Editors

Andrew English, John Galvin, Jim Gorman,
Chris Grundy, Carl Hoffman, John Pearley Huffman,
Dan Koepfel, Fred Mackerodt, Joe Oldham,
Barbara S. Peterson, Elizabeth Svoboda,
Kalee Thompson, Joseph Truini, James Vlahos,
Basem Wasef, Kevin A. Wilson, Barry Winfield

Contributing Photographers & Illustrators

Chris Buck, Jamie Chung, Christopher Griffith,
Dennis Kleiman, Martin Laksman, Mark Mahaney,
Axel de Roy, Dan Saelinger, Sarah Shatz,
Vladimir Shelest, Art Streiber, Dan Winters

Special Projects Team

Joseph Broda, Heather Lockwood Hughes,
Julia Knetzer, Keziah Makoundou, Allison McCann,
Paula Rackow, Greg Robertson, Steve Rousseau,
Janet Stafford, Katrina Zook

Employee of the Month

Robin Tribble keeps us from mangling the English language. Tops in her discipline, she ran an all-star panel on editing tablet apps at the 2011 American Copy Editors Society conference. She's also an avid quilter, curry-maker, bowler, and online gamer.

BILL CONGDON

PUBLISHER & CHIEF REVENUE OFFICER

ASSOCIATE PUBLISHER **Jane Wladar** GENERAL MANAGER **Bruce Mitnick**

Integrated Marketing

EXECUTIVE MARKETING DIRECTOR **Mike Kresch**
ASSOCIATE PUBLISHER/MARKETING **Zvia Herrmann**
MARKETING DIRECTOR **Barbara Serino**
CREATIVE DIRECTOR **Glen Fuenmayor**
SENIOR MARKETING MANAGERS **Deanna Ambrosio, Bonnie Harris**
MARKETING MANAGERS **Chad Meany, Amanda Luginbill**
ASSOCIATE MARKETING MANAGER **Carolyn Yanoff**

Administration

ADVERTISING SERVICES MANAGER **Patti Burns**

Digital

ONLINE ADVERTISING DIRECTOR **Matthias Wolf**
ONLINE MARKETING COORDINATOR **David Thomson**

Production

GROUP PRODUCTION DIRECTOR **Karen Otto**
GROUP PRODUCTION MANAGER **Jackie Beck**
ASSOCIATE PRODUCTION MANAGER **Karen Nazario**

Circulation

CONSUMER MARKETING DIRECTOR **William Carter**

Advertising Sales Offices

NEW YORK
EAST COAST SALES MANAGER **Ray Rienecker** 212/649-2876
ACCOUNT AND APPS MANAGER **Cameron Albergo** 212/649-2901
ACCOUNT MANAGER **Matthew Schwagerl** 212/649-2902
ASSISTANT **Amanda Marandola** 212/649-2898

LOS ANGELES

CALIFORNIA SALES MANAGER **Anne Rethmeyer** 310/664-2921
ASSISTANT **Michelle Nelson** 310/664-2922
ACCOUNT MANAGER **Amy Suprenant** 949/610-0458
ASSISTANT **Jeff Haertle** 949/610-0446

CHICAGO

MIDWEST DIRECTOR **Richard Bisbee** 312/923-4819
MIDWEST DIRECTOR **Spencer J. Huffman** 312/984-5191
ASSISTANT **Yvonne Villareal** 312/984-5196

DETROIT

REGIONAL DIRECTOR **Melissa Homant** 248/614-6066 ASSISTANT **Toni Starrs** 248/614-6011
REGIONAL DIRECTOR **Robert Reynolds** 248/614-6120
HEARST MAGAZINES SALES, LLC

DALLAS

Patty Rudolph 972/533-8665 PR 4.0 MEDIA

SPECIAL SECTION SALES

Beth Boyle 914/461-3269 SPECIAL ADVERTISEMENTS

DIRECT RESPONSE ADVERTISING

SALES MANAGER **Brad Gattelfinger** 212/649-4204
ACCOUNT MANAGER **John Stankewitz** 212/649-4201

CLASSIFIED ADVERTISING REPRESENTATIVE

Kathleen Gleason 888/473-0788; FAX: 708/352-4094 KLASMARK

SENIOR VICE PRESIDENT & PUBLISHING DIRECTOR, MEN'S GROUP **Jack Essig**

PUBLISHED BY THE HEARST CORPORATION

Frank A. Bennack, Jr.
EXECUTIVE VICE
CHAIRMAN & CHIEF
EXECUTIVE OFFICER

George R. Hearst, Jr.
CHAIRMAN

Steven R. Swartz
CHIEF OPERATING
OFFICER



HEARST MAGAZINES DIVISION

David Carey
PRESIDENT
Gilbert C. Maurer
PUBLISHING
CONSULTANT

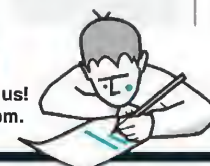
Michael Clinton
PRESIDENT, MARKETING
& PUBLISHING
DIRECTOR
Mark F. Miller
PUBLISHING
CONSULTANT

John P. Loughlin
EXECUTIVE VICE
PRESIDENT & GENERAL
MANAGER

Ellen Levine
EDITORIAL DIRECTOR

THE KID WANTS TO KNOW

Are you a kid with a question? Ask us!
Email popularmechanics@hearst.com.



"What would happen to us if the Earth suddenly stopped spinning?"

*Owen D., 3,
Norwalk, CT*

Gabriela Gonzalez, professor of physics and astronomy at Louisiana State University, says we'd be hurled off the planet. "Normally, the Earth, us, and everything else rotate together," she says. So even if we're standing still, we're moving in circles. Think of us like a stone spinning on the end of a string. "When the string breaks, the stone flies off in a straight path," she says. In this case, we would be the stone—speeding through space at about 900 mph. Which would be cool, if you could survive. — *Steve Rousseau*



Easy to apply.

No hot tire pick-up.



100% Guaranteed Performance.



Durable no peel surface.

**DON'T RE-DO
THE GARAGE.
REINVENT IT.**



Rust-Oleum's EPOXY SHIELD Garage Floor Coating brings the latest technology to your garage. With a simple roll-on application you can create a stunning showroom finish. And its unsurpassed performance is 100% guaranteed. So go ahead and add a new room to your house this weekend.

RUST-OLEUM®

THIS CHANGES EVERYTHING.

WWW.EPOXYSHIELD.COM

PopularMechanics.com

AUTOMOTIVE SCIENCE TECHNOLOGY HOME HOW-TO CENTRAL VIDEO

ON THE WEB

The magazine you hold in your hands is just one piece of the PM universe. Visit PopMech.com to read the confessions of an email hoarder, see 10 perfect jobs for DIY beginners, and find great stories like these:

TOP CULT CARS

A car need not be a VW Beetle, Chevy Corvette, or Porsche 911 to have a legion of dedicated fans. There are plenty of cars that, while flying a little under the radar, still attract a passionate following. Here are 10: popularmechanics.com/cultcars

LOOK INSIDE AN AURORA

Ben Longmier became fascinated with the aurora borealis as a 10-year-old boy. Now he's a rocket scientist, but in his spare time Longmier recently took a team to Alaska to send balloons carrying GoPro cameras to record the aurora from the inside. popularmechanics.com/aurora

WILD DIY GUITARS

The Gibson Les Paul isn't for everyone—some musically inclined DIYers just have to craft their own axes. These crazy homemade instruments need to be heard and seen. popularmechanics.com/guitars



FOLLOW POPMECH

For plenty more from our editors, follow Popular Mechanics on:

Twitter
[@PopMech](https://twitter.com/PopMech)

Facebook
facebook.com/popularmechanics

Tumblr
popmech.tumblr.com

IGNITION

NOTHING BEATS WRANGLER

COMFORT



Wrangler

Real. Comfortable. Jeans.

Room where you need it.
Comfort where it counts.



To learn more visit
wrangler.com/popularmechanics



WE ARE
WHAT
YOU
MAKE

Join us for the
Great Create,
a celebration
of amazing
creations and
the parts
that made
them possible.

Learn more at
www.RadioshackDIY.com



RadioShack.





good state



better state

Real savings should fold, not jingle. Make sure you get all the discounts you deserve. Talk to a State Farm[®] agent about a FREE Discount Double Check[®], or go to statefarm.com[®] today and keep your savings crisp.

Get to a better State[®]. Get State Farm.



**LG**

Life's Good

HE GETS IT.

The troops are advancing. Your pulse is pounding. Hey, this game just got way too real. When you're ready for the thrill of 3D, you're ready for LG Cinema 3D TV. Only LG delivers this total-immersion attack plan: the brilliance of Full HD 3D picture quality, enough battery-free glasses to keep the whole gang on the edge of their seats, 2D to 3D conversion, a Magic Remote, and a virtually frameless Cinema Screen design. Experience the rush yourself and feel the Force with Kinect™ Star Wars™ on Xbox 360. Because you don't get it 'til you got it!

ONLY LG's GOT IT.



Kinect™ Star Wars™ on Xbox 360
ESRB Rating: TEEN with Mild Language,
Mild Suggestive Themes, Violence



"LG HAS A BIG WINNER
ON ITS HANDS." -Digital Trends

LG CINEMA 3D
Smart TV

For more information, visit www.lg.com

LucasArts, the LucasArts logo, and STAR WARS TM & © 2012 Lucasfilm Ltd. All rights reserved. Kinect™ Star Wars™ game sold separately. Design, features and specifications are subject to change without notice. Digital Trends quote references 55" Class (54.6" diagonal) LM6700 Cinema 3D LED TV with Smart TV. For a small percentage of the population, the viewing of stereoscopic 3D video technology may cause discomfort such as headaches, dizziness or nausea. Visit www.lg.com for details. © 2012 LG Electronics, Inc., Englewood Cliffs, NJ. LG Design & LG Life's Good are trademarks of LG Electronics USA, Inc. Screen image is simulated.

Tech

WATCH

NEWS

TRENDS

BREAKTHROUGHS

SPACE TRAVEL

Bespoke Suit

NASA may not know whether its next destination is an asteroid, Mars, or the moon, but the agency is definitely planning for some kind of journey—and its engineers need to figure out what to pack. “It’s like you’re trying to go on vacation, but you don’t know if you’re going to Antarctica, Miami, or Buckingham Palace,” says Amy Ross, a spacesuit engineer at Johnson Space Center. The Z-1 prototype—currently being tested in a vacuum chamber—has been designed for versatility: to explore alien surfaces, float outside a space station, and even weather the radiation of deep space. “We’re building a lot of tools for the toolbox,” Ross says. “Right now we’re asked to be very flexible.” — MARY BETH GRIGGS

AMY ROSS, ENGINEER

1. PORT Astronauts step into the full suit through the back port. This port will mate with the spacecraft, enabling an astronaut to enter the suit from inside the craft for extravehicular activity. Another advantage: When used in low to no atmosphere, the port conserves more air than a conventional air lock.

2. MOBILITY The Z-1 has bearings at the waist, hips, upper legs, and ankles to allow an astronaut greater mobility—essential for retrieving soil and rock samples in tough terrain.

3. MATERIAL This provisional outer covering conceals a heavily engineered inner suit; a layer of urethane-coated nylon retains air, and a polyester layer allows the suit to hold its shape.



TECH CULTURE



HOW IT WORKS

- To begin swinging, an actor jumps off a crane wearing a harness that's wired to a pulley, in turn attached to an electronic winch.
- As he reaches the bottom—traveling 40 mph and pulling 3 g's—and begins to arc upward, an operator moves the pulley forward 50 feet. "It's like cracking a whip, where it goes along, stops, goes along, stops," says stunt coordinator Andy Armstrong. "We did that two or three times." The wires were erased in postproduction.

Full Swing

Spider-Man would be nothing without his swing. To create the character's signature web slinging in *The Amazing Spider-Man*, out July 3, stunt coordinator Andy Armstrong studied slow-motion footage of gymnasts, then built one-of-a-kind rigs to allow actor Andrew Garfield and the film's stuntmen to emulate their motion. The team used the aluminum-truss system in many locations: One track, built under a bridge in New York City, was 180 feet long; another rig hung off an old firetruck to make it look as though Spider-Man is swinging through traffic. The system enabled director Marc Webb to get more realistic web slinging than ever before—a fact that delights Armstrong. "A lot of kids have grown up with video games and computer-generated characters," he says. "There's still something much more exciting about seeing a real human do something that we'd all love to do if we had the ability." — ERIN MCCARTHY

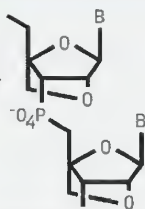
TECH WATCH



A MARCH 2012 SURVEY found that 11 percent of Americans have seen a TV weather forecaster mention global warming five or more times in the past 12 months; 58 percent would like to hear a forecaster talk about it.

DIAGRAM BY MARTIN LAKSMAN (XNA MOLECULE)

NEWS BRIEF / Weird Life



Every living thing on earth uses DNA or RNA to carry its instructions for life. These two nucleic acids are built from different sugars: DNA from deoxyribose and RNA from ribose. Now scientists have shown that at least six other types of sugars can form nucleic acid backbones—and they can be used to store and retrieve genetic information. Called XNAs (for xeno-nucleic acids), the new synthetic chains could address important questions about the origin of life. John Chaput, a team member and molecular biologist at Arizona State University, poses an even more tantalizing one. "Could you create synthetic life with it?" he asks. "That's possible, but it's much further down the road." — SARAH FECHT

GREAT THINGS CAN COME OUT OF SWEAT.
DON'T LET ODOR STOP YOU.



Gillette

ODOR SHIELD

**HELPS ELIMINATE ODOR,
NOT JUST COVER IT UP.**

THE BEST A MAN CAN GET™

60-SECOND GENIUS



Jon Mukand, M.D.,
author and
principal investigator
for BrainGate

Q. How is the human brain like a computer?

One major similarity is that both the brain and the computer have intricate circuitry; but the brain has many, many more connections because it contains 100 billion neurons.

The other similarity—and we used this in research for the BrainGate—is the logical processing of information that occurs in both the brain and the computer.

We placed an array of 100 electrodes, each thinner than a hair, in a paralyzed patient's brain, at the area that controls the hand. Then we recorded nerve signals from this array while asking the patient to imagine moving a computer cursor. The BrainGate software correlated specific patterns of nerve activity with specific intentions of the patient, and stored this information. (Brains and computers both have memories.)

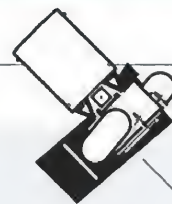
When the patient wanted to move the cursor, the software figured out that X pattern of nerve activity meant the patient wanted to perform Y task: to check emails, control a TV, or even move a robotic hand.

— AS TOLD TO
DALENE ROVENSTINE



SPACE ENTREPRENEURS

Rock On



SPACE PROSPECTING
TELESCOPE

WHY MINE SPACE ROCKS?

A 23-FT-DIA., 500-TON ASTEROID COULD HAVE A HEFTY AMOUNT OF RESOURCES.

0.0015%

PLATINUM GROUP

This might seem like a small concentration of the precious metals—only 7.5 kilograms—but it's three times denser than the richest terrestrial deposits.

20%

WATER

Future astronauts could use the 24,000 gallons of H₂O for life support or convert it into rocket fuel.

18%

IRON, NICKEL, COBALT

Nearly 100 tons of common metals could be used for space-based manufacturing and for building space stations and habitats for colonies.



F



TECH WATCH

orget exploration. Forget tourism. Following the money, the next big development for space may be exploiting its resources. In April, a group of billionaire investors, space experts, and former NASA engineers announced ambitious plans to mine asteroids. Their company, Planetary Resources, is already constructing a telescope, which it expects to launch within two years, to prospect likely targets. Swarms of cheap robotic craft built on an assembly line would be deployed later to do the mining—water and ordinary metals would be used in space, while precious metals would return to Earth.

"Landing spacecraft on another planet is one of the most exciting and rewarding things you can ever do," Planetary Resources' president and chief engineer (and former JPL Mars mission manager) Chris Lewicki says. "But when you have an opportunity like we have to redefine how it can be done, that's really attractive." If the company succeeds, the payoff for investors such as Google's Larry Page and Eric Schmidt could be, well, astronomical. According to Peter Diamandis, CEO of the X Prize Foundation and a Planetary Resources co-founder: "A 500-meter asteroid of the [optimal] metal chondrite contains more . . . precious metals than have ever been mined in the history of humanity." That's awfully attractive, too. — MICHAEL BELFIORE

1&1 MY WEBSITE

BUILDING A BUSINESS WEBSITE IS EASY.

No matter what type of business you have, 1&1 MyWebsite comes with customizable industry designs, making it easy to create the perfect website for your business. Professional text recommendations and corresponding images for your business are automatically implemented on your website as a starting point, and you can make whatever individual adjustments you need, such as changing designs, pictures, and text.

SELECT Your Business Type		CHOOSE Your Color Scheme		CUSTOMIZE Your Website With Text Pictures & More		YOU'RE ONLINE!	No software installation or web design experience required.
---	---	--	---	---	--	---------------------------	---

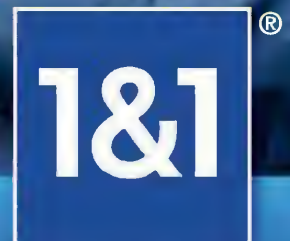
No waiting, no worrying and no extra costs. Unlike sites that are designed and built by web designers, when you build your site with 1&1, you're in complete control. All you need is an internet connection and you can make any changes online in real time.



**1&1 MY WEBSITE
TRY IT FOR
FREE!**

30 day free trial, then just \$9.99 per month*

**Includes a FREE .COM
domain with Private
Registration.**



Call 1-877-461-2631

www.1and1.com

*12 month minimum contract term applies after 30 day free trial. 1&1 and the 1&1 logo are trademarks of 1&1 Internet, all other trademarks are the property of their respective owners. © 2012 1&1 Internet. All rights reserved.

NEWS BRIEF /
Shape-Shifting Sand



How do you become the most popular kid at the MIT schoolyard? Build a giant box of "smart sand." Within moments, the sand will form a perfect replica of any object buried in it, scaled to whatever size is desired. At the university's Computer Science and Artificial Intelligence Laboratory, researchers have used 3D computer simulations to show that grains of smart sand can figure out the borders of the item to be duplicated, then communicate with one another to organize the copy. They also built prototypes—cubes of "smart pebbles" about a centimeter wide. Tiny processors and electropermanent magnets enable the pebbles to connect and disconnect from their neighbors on command.

— A.H.

TECH WATCH



ILLUSTRATION BY RYAN BRINKERHOFF

JUST CURIOUS

Core Competency

PM TECH EDITOR GLENN DERENE NERDS IT UP WITH U.S. SECRETARY OF ENERGY **STEVEN CHU** ABOUT THE WORLD'S FASTEST COMPUTERS.

Q. Have you had any personal experience with supercomputers in your research career?

A. When I was an undergraduate at the University of Rochester, I had a summer job where I programmed Control Data supercomputers. Later, when I was working at Stanford [University] and Berkeley [National Lab], I was on the board of directors for the graphics chip-maker Nvidia. Today, Nvidia's GPU chips are used in four of the top 10 supercomputers in the world.

Q. Today's fastest computers operate in petaflops [10^{15} operations per second], and there's a national initiative to move toward exascale computing, which would increase processing speeds a thousandfold. How much computer do we really need?

A. When you're doing baby calculations—Excel calculations and graphing—your laptop is all you really need. For solving differential equations, the current generation of supercomputers is pretty good. But once you go into big-time simulations—climate or jet engine or fuel injection—for the next factor of 100 to maybe 1000 you want more.

Q. What effect have supercomputers had on global competitiveness?

A. [Supercomputers are] directly related to a country's industrial sophistication. But it's deeper than being the biggest guy on the block. At the DOE, we see supercomputing as being more and more of an industrial tool. The benefits filter down to everything from the aerodynamics of cars and trucks and airplanes to the efficiency of jet engines and high-performance buildings.



ANIMAL COMMUNICATION

Hot Stuff

Using a realistic "robosquirrel"—a taxidermic ground squirrel with a mechatronic tail—a team of engineers from the University of California, Davis, and biologists from San Diego State University are studying the evolutionary arms race between squirrels and rattlesnakes. When the robosquirrel waves and heats its tail, mimicking the animal's behavior, snakes in the wild back off. This confirms that adult squirrels use interspecies infrared communication and that rattlesnakes rely on IR-sensitive pit organs more than their eyes. — ALEX HUTCHINSON



Dry time matters



minutes

VS.



hours



Introducing Krylon® Rust Protector™, the only rust paint with an amazing dry time of just 8 minutes. No more waiting over 2 hours for a project to dry with the leading rust competitor. No more worrying about dust and dirt ruining the finish. No more settling for the old way.

For proven corrosion protection that works and works fast, look for new Krylon® Rust Protector™.

Performance You Don't Have To Wait For™.

Follow us on:



krylonrustprotector.com
© 2012 Krylon Products Group



ADVENTURE

Riding Shotgun

TECH WATCH

SEMIWING COASTER

Skyrush in Pennsylvania's Hersheypark is a semiwing coaster—built by Intamin—with two seats centered over the track flanked by winged seats that offer 270-degree views of the park.

MAXIMUM SPEED:

75 mph

TOP VIEW: SEATS

maximum height:
200 feet

FULL VIEW: COASTER

track length: 3600 feet



TRUE WING RIDER

Both Dollywood in Pigeon Forge, Tenn., and Six Flags Great America in Gurnee, Ill., opted for true Wing Riders—built by Bolliger & Mabillard—with four fully cantilevered seats per row.

"It's the closest thing to flying. With the smooth sense of rolling, pulling of g-forces, and screaming dives—it feels very similar."

— MARK CUTMORE,
FORMER RED ARROWS
FIGHTER PILOT, ON
TESTING A WING
RIDER IN CHERTSEY,
ENGLAND'S THORPE
PARK IN FEBRUARY

This spring, three U.S. amusement parks debuted a new breed of roller coaster—delighting adrenaline junkies and horrifying the friends they drag along. These wing coasters have cantilevered seats, which amplify their movement and better simulate the sensation of flight. Passengers experience up to 5 g's in three directions. Shifting people's weight from the center of the track posed engineering challenges: Loads on the floorless seats are nearly three times greater than on traditional ones, so Hersheypark chose to mill each 2-ton car frame for its Skyrush coaster from one large piece of steel. — ALLISON MCCANN



Your music never sounded so good.



QuietComfort® 15

Acoustic Noise Cancelling® headphones

Welcome to a better sounding world, where your music comes alive as never before. The QC®15 headphones are our best, with Bose® technologies that deliver sound more naturally than conventional headphones. And a significant improvement in the noise reduction helps you focus on each nuance of your music, as distractions fade into the background. "These are fabulous," says Murray Hill of Canada.com. "Simply put, the sound is beautiful." It's a difference you need to hear to believe. We're so sure you'll be delighted, we'll even pay to ship them to your door.

To learn more: 1-800-760-2749, ext. Q8517
Bose.com/headphones

©2012 Bose Corporation. The distinctive design of the headphone oval ring is a trademark of Bose Corporation. Quote reprinted with permission.

BOSE
Better sound through research

NEWS BRIEF / Viking Mice

ILLUSTRATION BY RYAN BRINKERHOFF

When Norwegian Vikings sailed off to loot and pillage, they inadvertently took mice with them. By digging up the bones of ancient rodents and comparing their DNA to modern house mice, an international team of researchers is retracing the various phases of human migration across the Atlantic. Mice from 10th- to 12th-century settlements in Iceland and Greenland have the same DNA markers as the Viking stowaways. Today's mice in Iceland do too, with very little genetic variation in the population (just like the island's human population). In Greenland, on the other hand, modern house mice aren't related to the Viking species—a more recent wave of immigration wiped them out. Similarly, there's no trace of Viking DNA in house mice living in Newfoundland, the farthest west the Vikings reached. — A.H.

TECH WATCH

ATMOSPHERIC SCIENCE

Government Chemtrails (Really!)



Usually when strange cloud formations appear in the sky, anyone blaming government experiments can be easily dismissed as a paranoid crackpot. Not this time.

On March 27, NASA launched a volley of five rockets from its Wallops Flight Facility in Virginia. The rockets released a chemical tracer, called **TMA**, that produced milky clouds visible from Wilmington, N.C., to Buffalo, N.Y. But the purpose of the experiment was less nefarious than mind control or behavior modification: The agency wants to learn about the volatile high-altitude jet stream 60 to 65 miles above the ground.

Winds in the upper jet stream can exceed 300 mph, and strong electrical turbulence there can disrupt radio and satellite communications. By studying how the tracer clouds drifted apart, along with pressure and temperature data from sensors onboard two of the rockets, researchers will be better able to model this region of Earth's atmosphere.

— ALEX HUTCHINSON

GLOSSARY



TMA Trimethylaluminum produces aluminum oxide, carbon dioxide, and water vapor when it reacts with the air. NASA has used TMA to study the near-space environment for decades. It can burn skin, but NASA says the high-altitude release poses no threat.

MTM SPECIAL OPS

BUILT FOR ACTION

GI JOE
RETALIATION
IN THEATRES JUNE 29



MODEL	MTM BLACK COBRA	NEOPRENE STRAP
-------	-----------------	----------------

WWW.SPECIALOPSWATCH.COM



THE MTM SPECIAL OPS LINE OF TACTICAL TIME PIECES IS
EXCLUSIVELY AVAILABLE THROUGH MTM.
TOLL FREE AT 1 800 284 9487 OUTSIDE OF USA 1 213 741 0808
1225 SOUTH GRAND AVE. LOS ANGELES, CA. 90015.

GoPro
Be a **HERO**.



World's Most Versatile Camera

Wear it. Mount it. Love it.



HD HERO2
2X MORE POWERFUL
MSRP: \$299.99

11MP Professional Sensor
2X Sharper Glass Lens
2X Faster Image Processor
1080p | 960p | 720p | WVGA
Full 170° | Medium 127° | Narrow 90° FOV
120 | 60 | 48 | 30 Frames Per Second
11MP Ten Photo Burst / Second
Wi-Fi BacPac™ + Wi-Fi Remote Compatible

gopro.com

FEATURED EXPANSION ACCESSORIES



Wi-Fi Combo Kit
(Wi-Fi BacPac + Wi-Fi Remote)



LCD BacPac™



Battery BacPac™



3D HERO® System



Chest Mount
Harness



HD HERO
Wrist Housing



Head Strap Mount



Suction Cup
Mount



Handlebar Seatpost
Mount



Vented Helmet
Strap

HyperKewl
Evaporative
Cooling
Ranger Hat
[\$30]: Soak
it in ice
water. Put it
on your head.
Chill out.

GEAR

TOOLS

GADGETS

Upgrade

Beach-Geek Chic

The biggest dork on the beach used to be a conspicuous character. He carried a huge red cooler, made camp under an umbrella as big as a parachute, and snapped photos with a clunky SLR. But today the beach geek hides in plain sight. So discreet are his techy accessories (except for the metal detector) that he blends in with other sun worshippers. He's like a pale James Bond, with underwater goggles that record in hi-def and an iPhone-enabled pocket microscope. It's a sign of the times: This guy is actually cool. — JOHN BRANDON

Metal Detecting 101: Hunt just after dawn in high-traffic areas. Move the detector in a tight zigzag pattern. Have patience, friend: The good loot won't give up easily.



TREASURE SEEKER

Bounty Hunter's Tracker IV Metal Detector (\$110; hayneedle.com) has a waterproof coil and a range of about 8 inches for small objects and 3 feet for larger ones.



FOLDING THRONE

This Sport Brella Chair XTR (\$65) has more bells and whistles than a boardwalk arcade. The 46-inch canopy rotates 360 degrees and tilts 180 degrees. The insulated side compartment stashes up to four beverages (okay: beer), one of which fits nicely in the armrest cup holder.



UPGRADE



BEACH BOOMER

Yamaha's rugged PDX-11 speaker dock (\$100) connects with any smartphone. The sound quality is clear and rich, and we like the remote—no getting up to change tracks!



SPRAY COOL

With a high-speed fan and up to 1.5 hours of use per refill, the Windchiller Personal Mister (\$25) produces cool vapors on even the hottest, sunniest days.



GOING DEEP

The fog-resistant coating on Liquid Image's Free-style 330 swim goggles (\$99) keeps the picture clear as you capture HD video and stills of your adventures in the surf.



A REAL LOOKER

Snap macro shots of seashells with Carson's MM-250 iPhone adapter (\$25) and MM-200 pocket microscope (\$19), which provides a 60x to 100x optical zoom.



HOMEOWNERS INSURANCE. NOW AVAILABLE AT YOUR FAVORITE ONLINE INSURANCE STORE.

Progressive homeowners insurance is just one more way to get the kind of savings you expect from Progressive. Plus, you can save even more when you bundle your home and auto policies. Saving you time and money. Now that's Progressive.

1-800-PROGRESSIVE / PROGRESSIVE.COM

PROGRESSIVE®

Homeowners insurance underwritten by Homesite Group Incorporated, Boston, MA, IDS Property Casualty Co., DePere, WI, and ASI Lloyds, St. Petersburg, FL, and their affiliates, who are not affiliated with Progressive and are solely responsible for claims. Not available in AK and FL. Auto insurance underwritten by Progressive Casualty Ins. Co. & its affiliates, Mayfield Village, OH. Auto insurance prices and products are different when purchased directly from Progressive or through independent agents/brokers. Bundling discount not available in all states. 11D00067.PM (04/12)



○ VAMPLIERS

Rusted, stripped, or otherwise problematic screw heads, bolts, and nails are no match for VamPLIERS (\$35). Horizontal and vertical scoring on the jaws helps to provide a "vampire-like" grip (those are the manufacturer's words, just in case you missed the pun) for easy extraction—of metal, not blood, we hope.



○ BLACK DIAMOND EQUIPMENT MAGNETRON ROCKLOCK

Threaded or spring-loaded sleeves secure the gate on most locking carabiners, which can be tricky to manipulate. The Magnetron Rock-Lock (\$25) simplifies the process with auto-locking magnets. To release, simply press inward. The clip can easily be opened with one hand but remains securely locked when closed.

○ BIOLITE CAMPSTOVE

The BioLite Camp-Stove (\$129) is a true multitasker. Igniting small twigs and leaves in the fire chamber creates thermal energy, which is converted into reusable energy that can power small devices hooked into a USB port—all while cooking your dinner. Collapsed, it's about the size of a large Nalgene bottle. But at 2 pounds, it might be a bit too heavy for campers on long-distance hikes.



○ SWIVL PERSONAL CAMERAMAN

How can you record video of yourself without looking like a total stiff? The Swivl Personal Cameraman (\$180) provides an answer. Slide your phone into the dock, snap the marker to your lapel or collar, and hit record. The lens follows the marker to keep you in frame. Destined to become a staple of vloggers and video chat-ers, the Swivl brings quality camera tracking to the masses.

THIS LIGHT BITES



andymen used to hold a flashlight with their teeth to illuminate a work area.

Blackfire's **Clamplight** [\$30] has a swiveling head and adjustable beam and can either stand on a surface or clamp to a shelf, freeing up a worker's hands and preventing jaw pain.



SUFFERING FROM HEARTBURN DAY AFTER DAY IS AS UNNECESSARY AS WEARING SLEEVES.

Larry the Cable Guy
Actual user

Don't be one of them folks who gets heartburn and *then* treats, day after day. Block the acid by treating your frequent heartburn with Prilosec OTC[®] and don't get heartburn in the first place.*



ONE PILL A DAY.
24 HOURS.
ZERO HEARTBURN.*

*It's possible while taking Prilosec OTC. Use as directed for 14 days to treat frequent heartburn. Do not take for more than 14 days or more often than every 4 months unless directed by a doctor. Not for immediate relief.

© Procter & Gamble, Inc., 2012 PPAD11168

HOW IT WORKS/Paint Sprayer

UPGRADE

TECH & TOYS

Black & Decker's 2-Speed Quick Clean Sprayer (\$100) introduces two innovations that make painting everything from fences to sheds quicker and easier than ever. Here's how it works.



- Most sprayers require the operator to remove a **canister** and fill the reservoir from the top, which often leads to paint dripping from the draw tube and making a mess. Black & Decker's tool has a side-fill canister, which allows for quick, clean refilling.
- Set the **flow knob** to the desired intake—the higher the number, the greater the amount of paint sucked up and pushed out of the system—and switch on the machine; this kicks the solenoid motor into action.
- The motor drives a piston inside the sprayer at up to 7200 pulses per minute, creating suction that pulls paint up through the **draw tube**.
- The paint travels past the piston to the **atomizer valve**, which moves in a swirl pattern to break up the paint for spraying.
- Finally, the paint moves through the **spray tip**—choose between horizontal, vertical, and round spray patterns—and coats the surface.
- To clean the machine without taking it apart, simply pour water into the upper reservoir, flip the switch from paint to clean, and spray.



HOME EDITOR ROY BERENDSOHN ON WHEN TO SPRAY IT AND WHEN TO BRUSH IT

Brushing is great in small spaces and on long narrow surfaces, such as trim or the corner where the wall meets the ceiling. A sprayer produces a high-quality finish—on kitchen cabinet doors or furniture, for instance—and is also a good choice for rough, weathered wood surfaces that can snag a brush or roller's fibers.



**The Original...
just more affordable.**

**The Innovation...
just continues to grow.**



This summer,
exciting things
are to come
from FEIN.

NEW prices.
NEW accessories.
SAME trusted
superior quality.



Widest Variety

Tools now
starting from

\$199*

FEIN MultiMaster START Q



Engineered and
Made in Germany

As with the legendary FEIN MULTIMASTER, this summer, FEIN will be offering new, lower prices on the same high-quality accessories you've come to know, and love to use. In addition, FEIN is pleased to be introducing new accessories at great prices as well. With our now in-house, "Made-in-Germany" technology, outstanding accessories such as our E-CUT blades can be offered at more affordable prices. Our wide range of durable accessories provides solutions to whatever your application may be, with great performance and ease-of-use.

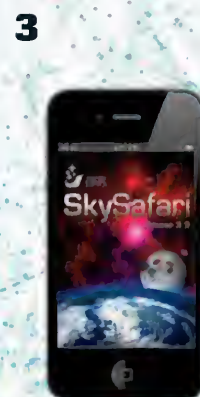
Whether it's the versatile FEIN MULTIMASTER or one of the many accessories to go with it, superior FEIN products are now more competitively priced than ever. More importantly, they're of the same authentic quality and reliability that FEIN has represented for over 140 years.

For more information or to find a dealer near you,
please visit www.themultimastersystem.com.

*MSRP

**FEIN. Unverwüstliche
Elektrowerkzeuge.**





UPGRADE

BY ERIN MCCARTHY

GEAR UP Amateur Astronomy

If you want to wish upon a star, first you need to track it down. Here's your stargazer's starter kit. —DALENE ROVENSTINE



1. SCOPE IT OUT

Many avid astronomers start with the AstroMaster 114EQ (\$250). Markings on the equatorial mount aid object location; a 4.5-inch aperture brings planets, stars, and nebulae into clear view.

2. NIGHT LIGHT

Hands-free illumination is key when trekking to your star-watching spot and setting up. Petzl's Tactikka XP Adapt headlamp (\$60) also attaches to a belt or pocket; a red filter gives night vision.

3. STAR SEEKER

Find what you're looking for with Southern Stars' SkySafari 3 App for iPhone, iPod, and iPad. The basic version (\$3) has a built-in compass and gyroscope, and catalogs 46,000 objects.

4. COOL AID

The double steel walls of S'well bottles (\$35 for 17 ounces; \$45 for 25 ounces) keep liquids hot for 12 hours or cold for 24 hours sans scalded hands or slippery condensation.

5. BUG BLOCKER

In our test, body parts covered by Columbia's Bug Shield Mesh Jacket (\$90) were bite-free after 30 minutes in the woods at night. We wish there were a hazmat suit made with this fabric.

6. SOLID FOOTING

The best stargazing takes place off the beaten path (thanks, light pollution!). Navigate tricky terrain in L.L. Bean's comfortable-as-sneakers Waterproof Trail Model Hiker midcut boots (\$99).

UPCOMING METEOR SHOWERS

JULY 28-29: Delta Aquarids; peak 20/hour; best viewed 2 hours before dawn.
AUGUST 12-13: Perseids; peak 50/hour; best viewed after midnight.

Optimizes Performance with Today's Ethanol Blended Fuels

STA-BIL®

Ethanol Treatment and Performance Improver

- Prevents corrosion
- Helps remove water from fuel
- Cleans fuel injectors, carburetors and intake valves for better, overall performance



LOVE TIM McGRAW?



Share your car story at
Facebook.com/Pennzoil
and you could win tickets
to see Tim live in concert.*



ENTER FOR A
CHANCE TO WIN



NO PURCHASE NECESSARY TO ENTER OR WIN. Void in AK & HI & where prohibited by law. Open to legal residents of the 48 contiguous U.S. (including D.C.), 18 or older (or age of majority in their state of residence, whichever is older). Starts 12:00 a.m. CT on 5/7/12, & ends at 11:59 p.m. CT on 8/19/12. There are 23 separate Contests, each one tied to a particular concert date & venue with individual Entry/Voting Periods (see Tour Dates tab on Facebook.com/Pennzoil for details). Limit 1 entry per person, per Contest. Non-winning entries/votes do not carry over; submit a new & different entry, per Contest. Limit 1 vote per person, per entry, per Contest. Prizes (23, 1 per Contest): a pair of tickets (for winner & adult guest) to a Tim McGraw concert (ARV: \$300 pair) & a VIP-only acoustic pre-show performance (promotional value only). Concert anticipated but not guaranteed to be in the city & on the date selected at time of entry. Limit 1 prize per person. For entry & voting requirements, judging criteria, prize details & limitations, see complete official rules at www.Pennzoil.com.

*Prize does NOT include transportation, meals or lodging.

©2012 SOPUS Products. All rights reserved.

EDITOR TESTED

SNOW PEAK
AJIKATAYA
HATCHET



NOT YOUR ORDINARY CHOPPER

When I'm channel-surfing and a late-night infomercial about knife collecting comes on, my hand freezes on the remote. You may picture me now, with an "L" for "Loser" tattooed on my forehead. But I find the knives and the cheesy sales pitch transfixing. Similarly, the Ajikataya hatchet (\$140) by Snow Peak cast a spell on me when it arrived at the office. No one in his right mind would pay \$140 for a hatchet. But grip the sculpted white oak handle. Behold the subtle arc of the blade, which is forged in Japan using a centuries-old method. Check the edge. Think about shaving with it, but don't—it's a hatchet! In my backyard I quickly carved a pile of branches into kindling. I used the lovely blade to whittle 2 x 2 lengths of pine lumber into easy-to-drive garden stakes. Power, precision, balance, history. Call me crazy, but I'm sold. — Joe Bargmann

LONG-TERM GADGET TEST

DEVICE: NIKE+ FUEL BAND

PRICE: \$149

TESTER: GLENN OERENE

TIME TESTED: ONE MONTH



WHAT'S IT SUPPOSED TO DO?

The FuelBand is a water-resistant clip-on electronic bracelet with accelerometers, a Bluetooth wireless antenna, and an LED dot-matrix display. A button toggles the display to Steps, Time, Calories, and NikeFuel, which is the company's own normalized measure of activity, regardless of the user's body mass.

HOW DID IT PERFORM?

The FuelBand is sturdy and comfortable. Its presence on your

wrist inspires you to move more smoothly. It can also be synced with an iOS device and computer to graph your progress toward your fitness goal. The problem is, regardless of how much science goes into Nike's algorithm, the NikeFuel metric feels arbitrary. The software allowed me to set my own goal of 2500 Fuel points. When I reached that goal, the display rewarded me with a celebratory animation, but I had no idea if I had achieved a healthy level of activity. — G.D.

UPGRADE

PHOTOGRAPHS BY STUDIO D

"CARS ARE A BIG PART OF
MY MUSIC, BECAUSE THEY'RE
A BIG PART OF MY LIFE."

-TIM MCGRAW

THE STORY CONTINUES BY
DOWNLOADING THE AURASMA
APP AND POINTING AT THIS AD.



LONG LOVE CARS.

Cars are a part of our way of life. And if you love cars as much as we do, you want to keep your engine running clean and strong for as long as possible. That's why Pennzoil® motor oil is formulated to help maintain engine cleanliness and to clean out sludge lesser oils can leave behind*. SEE TIM'S STORY AT [FACEBOOK.COM/PENNZOIL](https://www.facebook.com/pennzoil).

JOIN TIM MCGRAW AND PENNZOIL ON THE "BROTHERS OF THE SUN" TOUR.

Not just oil, Pennzoil.®



*Based on a severe sludge clean-up test using SAE 5W-30. ©2012 SOFUS Products. All rights reserved.

A turbo is essentially two fans connected by a shaft. One fan, the turbine, is spun by the engine exhaust, powering the other [the compressor], which pressurizes the air fed to the engine. The turbo is efficient because it uses normally wasted exhaust energy.

FRESH-AIR
INTAKE

COMPRESSED
AIR COLLECTS
IN THIS RADIAL
CHAMBER
AND FLOWS OUT
A DUCT (NOT
SHOWN) INTO
THE ENGINE

COMPRESSOR
WHEEL

RELIEF VALVE
ACTUATOR

SHAFT
CONNECTING
THE TURBINE
AND COMPRES-
SOR WHEELS

ENGINE
EXHAUST
FLOWS INTO
TWO DUCTS, THE
"TWIN SCROLLS"

TURBINE WHEEL

EXHAUST PORT

Auto

INTEL

Honeywell Twin-Scroll
Turbocharger

B

HORSEPOWER PUMPS

TO GET BOTH FUEL ECONOMY AND HORSEPOWER, AUTOMAKERS ARE BOOSTING ENGINES WITH PUMPS THAT PROVIDE EXTRA KICK WHEN NEEDED.

Big engines provide a satisfying surge, but most of the time we're using only a fraction of an engine's maximum power. To increase fuel economy, automakers are rapidly employing smaller engines—both in displacement and cylinder count. Down-sized engines can, however, produce big-motor power with the help of pumps that force more air into the engine. The extra air, combined with fuel, makes a

more powerful "boom" when the spark plugs fire, increasing horsepower.

Automotive engine pumps come in two flavors: turbochargers and superchargers. Turbos are currently the de facto small-engine power booster because they efficiently run off the engine's exhaust. This energy may be "free," but there's a slight delay between the time the driver presses the gas and when the turbo

The supercharger—or blower—pumps compressed air into the engine, increasing power. Since it's belt driven, like an alternator, the supercharger supplies boost in as little as 250 milliseconds.

BELT-DRIVE PULLEY

**MESHED GEARS
ROUTE POWER TO
THE SECOND ROTOR**

**TWO CAST-
ALUMINUM HELICAL
ROTORS SQUEEZE AIR
BETWEEN THE LOBES
AND PUSH IT TO THE
BOTTOM EXIT PORT**

**COMPRESSED AIR
EXITS OUT THE
BOTTOM AND
FLOWS INTO THE
ENGINE**

AIR ENTERS HERE



**Eaton Model TVS R410
Supercharger**

TEST DRIVES

TOP TECH

HOT RIDES



BY LARRY WEBSTER

generates boost (the delay is known as turbo lag). While turbo-makers have reduced the lag with twin-scroll ducts that increase gas velocity, surviving in the over 2000 F exhaust requires exotic and expensive materials like cast stainless steel and Inconel, a nickel-chromium alloy.

Superchargers have typically been employed when peak power—not saving fuel—is the ultimate goal (see the Corvette ZR1). But refinements like helical rotors and a bypass system for coasting have

increased the blower's efficiency so that several automakers are keen to take advantage of the supercharger's relative simplicity and lower cost. Plus, a supercharger offers near instantaneous response, so a downsized, supercharged engine feels punchier in heavier vehicles like SUVs. Compared with a nonboosted engine of equal power, a smaller "pumped" one is roughly 10 percent thrifter, which is why the majority of new-car engines will almost certainly be boosted by the end of the decade.

JULY



2013 Dodge Dart



2013 Ford Escape



2013 Ford Focus Electric



2013 Lincoln MKS



2013 Infiniti JX35



Ducati 1199

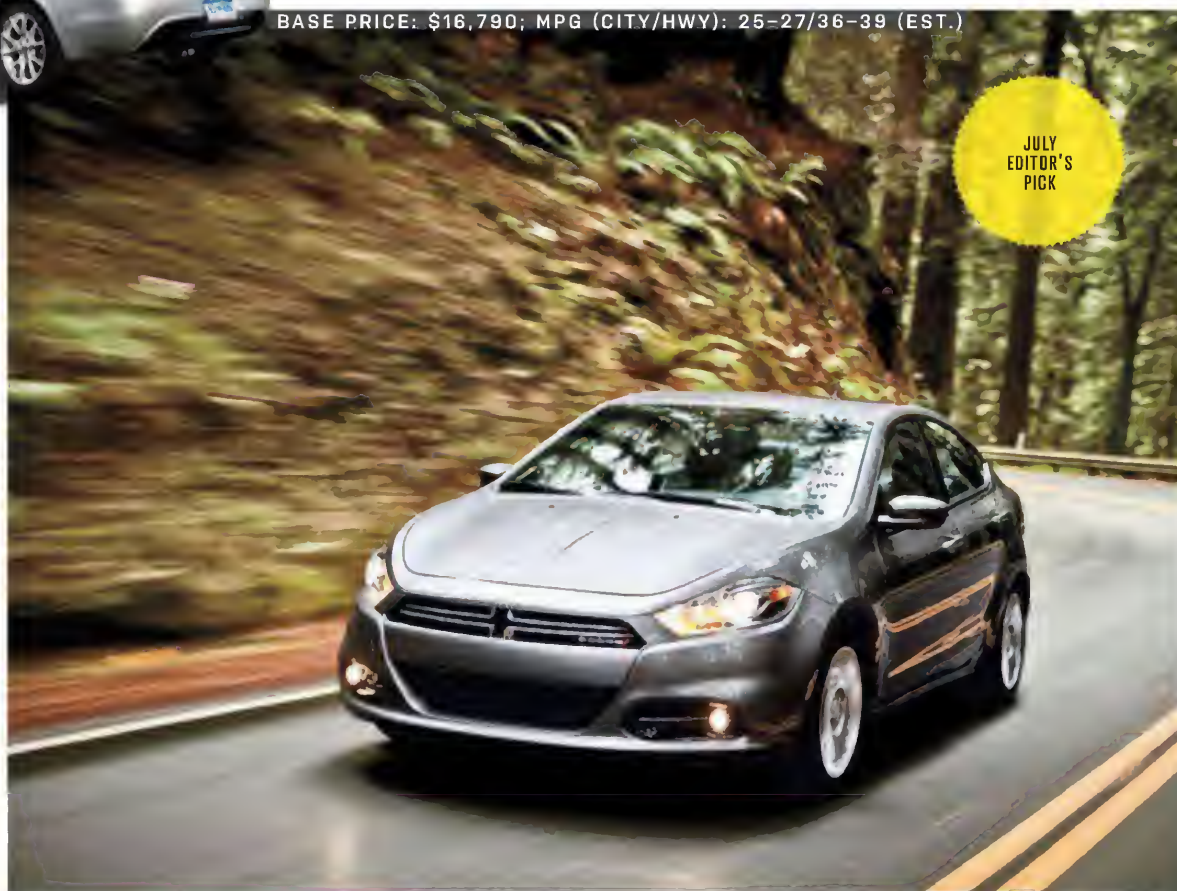
TEST DRIVES

2013 Dodge Dart

Dodge went without a traditional compact sedan for nearly seven long years. But now, thanks to an infusion of small-car know-how from parent company Fiat, there's a new Dodge Jr., built largely on the bones of the Alfa Romeo Giulietta. To make sure there's enough room for us girthy Americans, the Giulietta's chassis has been widened and stretched. But despite the increased size and heft, it's clear Dodge has a driver's car here, one that's extraordinarily well-composed. The suspension has just the right amount of compliance over the rough stuff, but it's firm enough to

handle hard cornering, with superb feedback from the electric power steering. Of the three offered engines, you'll want the optional turbocharged 1.4-liter in the SXT model that's priced from \$18,790. It produces the same 160 hp as the base 2.0-liter, spits out 184 lb-ft of torque (versus 145 lb-ft for the bigger mill), and has superior fuel economy: 39 mpg on the highway. Inside, the Dart has soft-touch materials placed wherever a hand or elbow may fall. If this little sedan is any indication, future Chryslers will have a welcome hint of European élan. — BEN STEWART

BASE PRICE: \$16,790; MPG (CITY/HWY): 25–27/36–39 (EST.)



AUTO INTEL

GLOSSARY

DESMODROMIC VALVETRAIN A system where there is no spring holding the valve closed. A rocker arm opens the valve and another closes it. The valves, therefore, always faithfully follow the cam lobes. The term desmodromic derives from two Greek words: desmo [bond] and dromos [path]. Ducati says the system provides more precise high-rpm valve actuation. That was true in the '50s, but today desmo is probably more effective as a marketing tool.

American Red Cross



Your support brings hope.

Recent tornadoes have destroyed many communities and left many families in need.

You can help.

Your donation to the American Red Cross can help provide a hot meal, comforting shelter and hope when it is needed most.

Visit redcross.org or text REDCROSS to 90999 to give \$10

Text REDCROSS to 90999 to make a \$10 donation to the Red Cross. Charges will appear on your wireless bill, or be deducted from your prepaid balance. Msg & Data rates may apply. Reply STOP to 90999 to STOP. Reply HELP to 90999 for HELP. Full terms and privacy policy: redcross.org/m


 AUTO INTEL

BASE PRICE: \$23,295
MPG (CITY/HWY):
20-23/29-33 (EST.)



2013 Ford Escape

After 11 years, there's finally a third edition of the Ford Escape. The truckish appearance and clunky dynamics are out, and the 2013 crossover gets taut handling with quick steering and little body roll. Some buyers may find the ride a bit too stiff, especially on over-pocked and potholed roads. There's a choice of three engines, but we prefer one of the two turbocharged EcoBoost four-cylinders—a 1.6-liter with 178 hp or the 2.0-liter with a full 240 hp. The 1.6-liter may sound undersized, but in reality the little tyke does a commendable job moving the

Escape. It's only when you need a boot full of throttle that you'll wish for more thrust. Or if you want to raise your heart rate: Pitch a 2.0-liter Escape deep into a corner and let the all-wheel-drive system sort out the power—you'll pull through without any drama. If you're aiming for fuel economy, buy the new 1.6. It gets an estimated 33 mpg (versus 28 mpg from the highest-mileage 2012 Escape), thanks in part to grille shutters that close at freeway speeds to improve aerodynamics. Smart.

— BEN STEWART



BASE PRICE: \$40,450
MPG (CITY/HWY): 18/23-24

2013 Infiniti JX35

What's new: Infiniti's first three-row crossover. Available with front- or all-wheel drive.

Driving character: Exceptionally quiet with smooth ride quality. Steering, however, is novocaine numb.

Roadblock: Engineers tuned the 265-hp V-6 and CVT for fuel economy but left out punch.

Latest march toward full

computer control: Optional Backup Collision Intervention system automatically hits the brakes if it computes an impact is imminent.

Alternatives: Over a dozen in the class. The JX is stuffed with standard features, but we still prefer the blue-collarish Dodge Durango.

TEST DRIVES

2012 Ducati 1199 Panigale



PRICE: \$17,995; MPG (CITY/HWY): N/A

There are six ECUs to regulate the complex array of electronics found in the Ducati 1199 Panigale, but this superbike's strong suit isn't its adjustable traction control, engine braking, or available suspension adjustability. What

gives this feisty Italian an edge over its worthy Japanese and German competitors is the signature rumble from its 1199-cc engine and that singular feeling of personality so intrinsic to the formula of a desmodromically valved (see glossary, previous page), big twin engine. Our day of riding the Panigale at the Formula One Circuit in Abu Dhabi saw high cornering speeds and an ultimate velocity of 170 mph. Yet for all the 1199's ferocity, it's still user-friendly—proof that Italian character doesn't have to be devoid of confidence-inspiring security. — BASEM WASEF





EXERCISE IN ONLY 4 MINUTES PER DAY

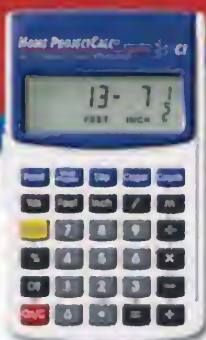
Special Forces looked at it in 1990 and finally purchased in 2010. Made in America. Good for ages 10 to 100. For strong or very weak and ill people. Diabetes, bad backs, shoulders, knees. Order a 30 day trial in your home or a free DVD online or call.

818-787-6460

RestartFitness.com



Save Time and Materials on All Your DIY Projects!



Model 8510

HOME PROJECTCALC®

Do-It-Yourself
Project Calculator

Simplify your home improvement and decorating projects with the easy-to-use Home ProjectCalc.

Learn more at www.projectcalc.com

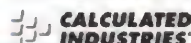
Available at:



See Product DEMOS on



www.calculated.com



RAINHANDLER



RAINHANDLERS NEVER NEED CLEANING because they CAN'T trap leaves!

Rainhandlers have no troughs or downspouts so there's nothing to clog or clean.

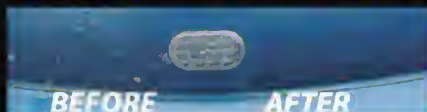
Rain running off your roof is converted to gentle drops in a 3 foot wide swath away from your home. Easy installation!

GREEN product - Conserves precious rain.

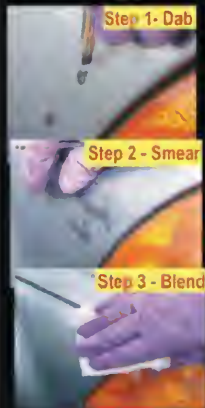
For free info phone 800-942-3004 or go to www.rainhandler.com. Ready to buy? Use code PM712 at checkout for extra 10% off!

DR. COLORCHIP® AUTOMOTIVE PAINT CHIP REPAIR SYSTEMS

Can Your Touch-Up Paint Do This?



Fast, Simple, Dramatic, Paint Chip Repairs
...with **NO PAINT BLOBS!**



- * All Factory Match Colors
- * Permanent Chip Repairs
- * No Clear Coat Needed
- * The Cure for Road Rash

Rated #1 by *The Wall St. Journal*
among paint repair products

See our website for photos
& video demonstrations

Our proprietary paint & blending
solution allow professional repairs
in minutes, not hours!

3 kit sizes: \$39 • \$49 • \$59

Order Your Paint Chip Repair Kit Today!

Drcolorchip.com (866) 372-2548

www.motionmodels.com

THE WORLD'S FINEST READYMADE AND CUSTOM TRUE MUSEUM
QUALITY AIRPLANE AND NAVY AND COAST GUARD SHIP MODELS



USS GEORGE H.W. BUSH CVN-77 CUSTOM MADE
FOR NORTHROP GRUMMAN AND PRESIDENT BUSH

MOST NAVY AND COAST GUARD SHIPS AVAILABLE

www.motionmodels.com

1-800-866-3172

Huge 66% Savings!

U.S. 1976 Bicentennial
Proof Set, Only \$9.95

With Special Commemorative Designs



FREE
Shipping
with code
N5271

OVER A THIRD OF A CENTURY OLD!

Get a low introductory price on this milestone 6-coin 1976 U.S. proof set. Its "Drummer Boy" quarter, "Independence Hall" half dollar and "Liberty Bell/Moon" dollar carried the first commemorative coin engravings in U.S. proof sets. Deep-struck, frosted engravings and dazzling mirror backgrounds. Reg. \$29. \$9.95 (#44417). NO ON APPROVAL COINS SENT. 30-Day No-Risk Home Examination: Money-Back Guarantee.

International Coins & Currency
62 Ridge St., Dept. N5271, Montpelier, VT 05602

1-800-451-4463

www.iccoin.com/deals

N5271

There are as few as
3,200 tigers left in the wild.

**Don't wait until
they're gone.**



SaveTigersNow.org

d.
I



Protect the future of nature

TEST DRIVES

2013 Lincoln MKS



BASE PRICE:
\$42,810
MPG (CITY/HWY):
17-19/25-27

With the Town Car's demise the MKS now reigns as Lincoln's biggest sedan, and it actually grows a little for 2013, with an elegant interpretation of Lincoln's split-wing grille adding 1.8 inches to its length. Beyond cosmetics, the biggest change is a new, standard Continuously Controlled Damping system that monitors shock settings over three driver-select presets (comfort, normal, and sport) and can vary responses up to 50 times a second. Thanks to the addition of the 3.7-liter V-6 from the Mustang, base-engine horsepower jumps significantly, from 274 to 304 hp, while overall fuel economy also jumps 2

mpg. The optional 3.5-liter twin-turbo V-6 gains 10 hp, to 365. Both engines are mated to six-speed automatic transmissions and front- or all-wheel drive. The big Lincoln isn't especially agile, and what sportiness it has is undercut by steering that lacks strong feedback. The sedan's *raison d'être*, however, is luxury, not bisecting apexes, and it shines more brightly in that department, with a very posh interior. The rebooted MyLincoln Touch infotainment system responds quicker to touch commands, but it still takes practice to master all the features. — TONY SWAN

2013 Ford Focus Electric

BASE PRICE:
\$39,995
(BEFORE TAX
BREAKS)
MPG (CITY/HWY):
110/99



What's new: Runs on electrons thanks to a 141-hp electric motor and 23-kwh lithium-ion battery pack.

Neat trick: With a 240-volt 32-amp charger, reenergizing the battery takes just 4 hours.

Driving character: Drives like the impressively refined and sprightly Focus, though a little lighter on the sprite.

Roadblock: Like all EVs, trip planning is critical. The range is about 76 miles.

Possible alternative: A \$17,295 base Focus that can refuel in under 5 minutes and go 400 miles on a tank.

WHEELHOUSE

AUTO ODDS AND ENDS

15.4

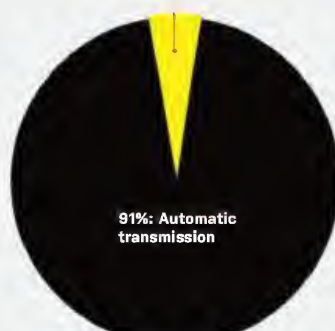
Percentage of cars sold by each automaker in California that must be zero-emission—EV, a plug-in hybrid, or hydrogen fuel cell—by 2025, as mandated by the California Air Resources Board (CARB).

1990

The year CARB enacted its first EV mandate, which required that 2 percent of cars sold in California be zero-emission vehicles by 1998. The rule was dropped in 1996 due to concerns that EV technology wasn't ready.

Sign of the times These automakers have research centers in **Silicon Valley**: Ford, BMW, Volkswagen, General Motors, and Mercedes-Benz.

9%: Manual transmission



TRANSMISSION TYPE FOR U.S. CARS SOLD IN 2011

Data: WardsAuto

\$30,748

Average price of a new vehicle sold in the U.S. in March 2012, setting an all-time record, according to price-tracking website TrueCar.com. The average for the previous March was \$28,771.

Only 35 percent of people who owned a hybrid bought another when new-car shopping in 2011, according to research from R.L. Polk. With improved internal combustion engines getting comparable mileage, the price premium might be a deterrent.



AUTO INTEL

INTRODUCING THE MICHELIN® DEFENDER™ TIRE

SAFER.¹ LONGER.²

90,000 MILES³ OF CONFIDENT DRIVING



Introducing the MICHELIN® DEFENDER™ tire, with the traction superiority to allow you to stop up to 31 feet shorter than a leading competitor¹ and industry-leading wear life technology that gives you a 90,000-mile limited warranty.³ That's up to 21,000 miles longer than a leading competitor² and why we say they help keep you safer,¹ longer.² Find out more at michelinman.com/defender



1 — Based on internal wet braking test results versus Goodyear® Assurance® ComforTred® Touring tire size 185/65R15.

2 — Based on commissioned third-party wear test results versus Continental® ProContact™ with EcoPlus Technology tire size 215/60R16.

3 — 90,000-mile limited warranty for H- and T-rated tires, 80,000-mile limited warranty for V-rated tires. See michelinman.com for warranty details. Copyright ©2012 Michelin North America, Inc. All rights reserved.

GRILLE TO GRILLE

SMART PLAY

Need proof that you don't have to drop a lot of dough for a quality new car? We tested three budget compacts on the roads around L.A.

AUTO INTEL



CATEGORIES	CHEVY SONIC LTZ	KIA RIO	TOYOTA PRIUS C
BASE PRICE/ AS TESTED	\$17,235/\$18,695	\$18,450/\$23,050	\$19,710/\$24,290
STANDOUT FEATURE	Drives like a sports car.	Looks fit for the Riviera—the good one in Italy.	No matter how hard we flogged it, it still averaged 44 mpg.
POWERTRAIN	138 hp, 148 lb-ft; 1.4-liter turbo-charged I-4/6M	138 hp, 123 lb-ft; 1.6-liter I-4/6A	73 hp, 82 lb-ft; 1.5-liter I-4; 60 hp, 125 lb-ft; electric motor, CVT
INTERIOR	Out of the three, only the Sonic's back seat is adult-friendly, with tall rear doors and a high ceiling that eases access and increases comfort.	The Rio's sexy, raked roofline is sweet—if you're the driver. And we dig the racy toggle switches used throughout. Those in steering have to fold themselves and duck to enter the back seat.	The C offers average roominess for the class, but engineers have carved out a surprising amount of storage. We counted nine different cubby spaces in the cabin.
0-60 MPH (SECONDS)	8.36	9.72	11.31
DRIVING CHARACTER	Unexpectedly refined, nimble, and eager.	Tries, but mostly fails, to live up to its good looks.	Indifferent.
HANDLING	The suspension is both compliant and precise—a rare combo.	Too soft for spirited driving. It bobs on its springs and requires constant steering corrections.	Utterly forgettable. There's more enjoyment monitoring the variety of fuel-economy meters.
WEIGHT (POUNDS)	2880	2660	2600
TRANSMISSION	The six-speed manual is an extra \$700 and worth every cent. Plus it gets 6 percent better fuel economy versus the automatic.	Want leather <i>and</i> a six-speed manual? Denied! The cheaper Rio LX's six-speed manual gearbox can't be paired with upgraded seats and navigation.	Ask this CVT to accelerate the car to 70 mph and the engine bay moans and drones.
BRAKING, 60-0 MPH (FEET)	118.4	124.04	123.89
ENGINEERING TRIUMPH	A domestically produced small car that drives like it came from Europe.	Umm . . .	The Prius has an electric motor and a battery pack, yet is still the lightest of the three.
EPA FUEL ECONOMY (CITY/HWY)	29/40	30/40	53/46
PM FUEL ECONOMY	34.40	36.50	44.30
THE BOTTOM LINE	We'd buy it simply for its driving dynamics. Add in the roomy rear seat, crisp exterior, and value pricing, and it's a runaway winner.	Kia nailed the appearance portion. Once the company tackles performance issues such as steering feel and handling poise, it could rule the industry.	Perfect for technoheads mainly interested in mpg.

VISIT MOTHER NATURE'S WATERPARK



GET YOUR FISHING LICENSE & BOAT REGISTRATION

IT'S QUICK. IT'S EASY. IT HELPS PRESERVE
THE LOCAL ENVIRONMENT.

SEARCH THE PLACES TO BOAT & FISH MAP

A DAY OF FUN IS WAITING ON THE WATER.
WE'LL SHOW YOU HOW TO GET THERE.

EXPLORE OUR FISHOPEOIA SECTION

LEARN ABOUT FISH, EQUIPMENT,
AND TECHNIQUES TO LAUNCH A
DAY OF EXCITEMENT.



TAKEMEFISHING.org

YOUR FAMILY'S GUIDE TO
GETTING OUT ON THE WATER.

OFFICIAL PARTNERS



DRAWING BOARD

2013 SRT VIPER

The 2013 SRT Viper stole the spotlight at this year's New York International Auto Show. Along with a new badge and a 640-hp V-10, the much-anticipated supercar features a modern and more functional take on its iconic shape, which dates to 1992. Here, Ralph Gilles, president and CEO of SRT, Chrysler senior vice president of design, and designer of the Chrysler 300, explains the Viper's new look. — ANDREW DEL-COLLE

A. Proportion

The Viper is what we call a cab-rearward proportion. It has a distinctive back-positioned cab with a very, very long nose. This allows the car to be a front-midengine car, where the engine is rearward of the front axle and gives the car 50/50 weight distribution.

B. Hood exhausts

The two new air extractors increase top speed a little bit, decrease pressure buildup on the nose of the car, and improve cooling by releasing hot air from the radiator. We shaped those scoops so the hot air goes around the windshield, not in the passenger compartment.

C. Front headlamps

The Viper's eyes have been horizontal slits with multiple headlamp projectors for a long time. We went to just a single projector and literally styled the eyes of the car after a snake's—a little bit more vertically oriented. The two LEDs—the upper is a turn signal; the lower is the daytime running light—almost appear to be pupils.



AUTO INTEL

"We wanted it to look like an organism, not a machine."
Ralph Gilles

D. Side gill

The side gill is unmistakably a Viper cue and helps remove air pressure and heat from the engine bay. This gill is almost two and a half times as wide as it's ever been, and 100 percent functional. In the past, it's only been decorative.

E. Differential cooling ducts

A performance car's differential works hard and gets pretty hot—almost hotter than any other part—so we designed an air path for cooling. The ducts also modernize and lengthen the canopy of the vehicle.

F. Roof tab

The tab that extends off the roof accentuates the double bubble and minimizes the appearance of the rear window. This gives the rear wheel arches prominence; they bulge because that's where the power comes from—the rear wheels.

G. Diffuser

The diffuser is a huge contributor to the downforce of the back of the car. I'm very proud of it. While it looks sculpted, it's completely functional. We have integrated backup lamps that are kind of hidden in there.

amazon.com



FREE Super Saver Shipping*
on thousands of automotive products,
tools, accessories, and parts for your car,
truck, SUV, motorcycle, and RV.

* On eligible Amazon.com orders of \$25 or more
Terms and conditions apply

[amazon.com/auto](https://www.amazon.com/auto)



Popular
Mechanics
**READERS'
CHOICE**
AWARD 2011

WHERE CAN MOBIL 1
EXTENDED PERFORMANCE
MOTOR OIL TAKE YOU?

Road Trip Checklist

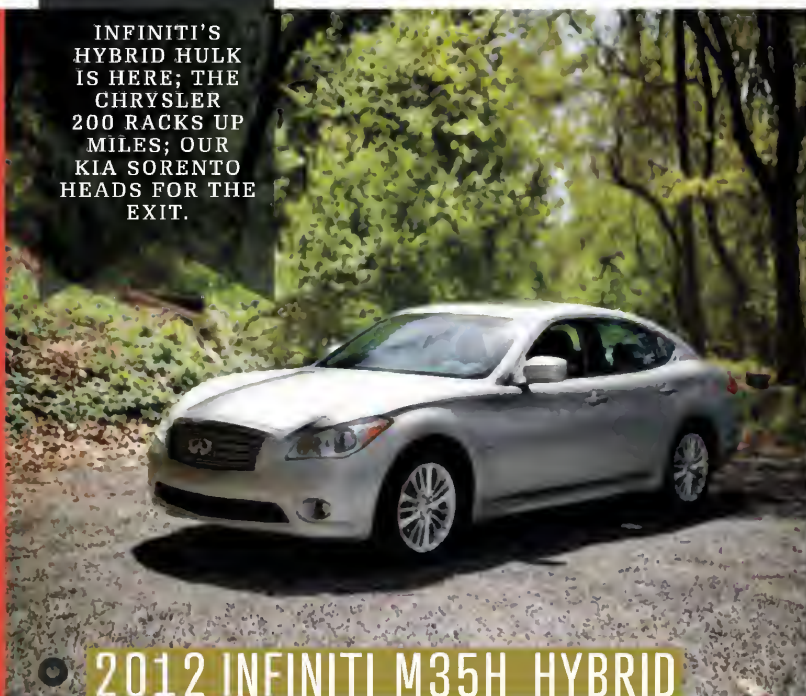
- ☐ Mechanic check-up
- ☐ Emergency Kit – tire sealant, jumper cables, first aid kit
- ☐ Tire pressure gauge
- ☐ GPS navigation unit and a backup road atlas
- ☐ Mobile phone car charger
- ☐ Snacks and plenty of water

Mobil 1™

Mobil 1 keeps your engine running like new.

POPMECH FLEET

INFINITI'S
HYBRID HULK
IS HERE; THE
CHRYSLER
200 RACKS UP
MILES; OUR
KIA SORENTO
HEADS FOR THE
EXIT.



2012 INFINITI M35H HYBRID

FIRST REPORT

C

an a full-size sedan deliver fun performance, luxury, and good mileage? That's the tricky combo Infiniti tries to nail with the M35h Hybrid. Here's our take after three months: Performance-wise, there is no disguising the heft of the lithium-ion battery pack when turning the wheel, but in a straight line, the two motors—gas and electric—combine for, ahem, electrifying acceleration. Luxury is present in spades with rich interior appointments and crisp Bose sound. The mileage, naturally, depends. Driven gingerly in Eco mode (a setting that combats lead-footing so aggressively it seems like the gas pedal is pushing back), the M returned 30 to 32 mpg in mixed driving. Spirited driving in Sport mode (ahh, that's better) yielded 24 to 26 mpg on the same commute. Not bad at all, considering the vehicle's size, though not the kind of numbers that will impress your Pious—we mean Prius—driving neighbors. But the M excels at higher speeds, seamlessly layering the electric motor's 199 lb-ft of torque atop the V-6's already adequate power. And the fun of that doesn't get old. — JIM MEIGS

VITAL STATISTICS

BASE PRICE ▶ \$53,700

AS TESTED ▶ \$65,955

EXTRA-COST OPTIONS ▶ Blind-spot and lane-departure warnings, Intelligent Cruise Control, Bose audio system, 8-inch touchscreen, navigation, 18-inch wheels

DRIVETRAIN ▶ 3.5-liter V-6 (302 hp, 258 lb-ft) with electric hybrid assist (67 hp, 199 lb-ft), 7A, RWD

COMBINED POWERTRAIN PERFORMANCE ▶ 360 hp



Be Prepared for the Open Road



Learn more about Mobil 1
Extended Performance
motor oil at mobil1.us

Before any long road trip, it's worth having a mechanic check that all your car's vital systems are in top shape. These key elements include brakes, hoses, belts and the various fluids—from engine oil to coolants—that make your car perform as it should. You could do this yourself, but you'll spend the first 100 miles worrying you missed something.



The emergency kit your father kept in the trunk still has its place. It should include old standbys like jumper cables, flashlight, duct tape, tire sealant, flares and a multi-function tool. But you're not driving your father's car anymore, and there are some things the modern driver should have on hand.

Before you hit the open road, check Apps like GasBuddy to find the stations with the lowest fuel prices. Have others in the car help find other Apps that can help with roadside assistance to tips on which services are available at the next exit.

Your cell phone isn't much good, however, if the battery is exhausted. A car charger for your phone is a must, but also bring an external battery pack in case the car battery fails.

Enter GPS navigation directions before you start driving so you don't wind up in the right town but the wrong state. Also, carry a backup road atlas in case GPS mapping software mislabels a road or routes you incorrectly.

Get a tire tread/pressure gauge with a digital readout. You'll spot tire wear faster and you'll be sure the tires are properly inflated for optimum gas mileage.

Lastly, obtain a NASA-developed solar blanket that reflects 90 percent of your body heat in case you're exposed to the elements. And make sure to pack water and energy bars. You can't think straight in an emergency if you're hungry and thirsty.

Whatever you do, be sure to use Mobil 1 Extended Performance motor oil. Proven to protect for 15,000 miles between oil changes.



2012 CHRYSLER 200

SECOND REPORT

In its first review, the 200's big trip was to Toronto. Now the stylish sedan has survived a marathon 2500-mile round-trip dash from New York City—through a mid-Atlantic snow-storm—to the Gulf Coast. The steering is smooth, and the car grips both icy interstates and blistering country roads with ease, thanks in part to its revised suspension. But after six months, we're wishing we had gone all in for the peppier 283-hp 3.6-liter V-6, as the 2.4-liter four-cylinder's pickup feels painfully sluggish at times. The smaller engine has, at least, often returned fuel economy in the high twenties. As for the infotainment and navigation system, the 200 has not been upgraded with Chrysler's latest Uconnect system, so we're left with a primitive nav screen. And one staffer had to have the computer reset after the system went rogue and ate a CD. Overall, however, the 200 has proved itself a comfortable ride over a long haul. — ALYSON SHEPPARD

PM FLEET CONTINUED

2012 KIA SORENTO SX AWD

FINAL REPORT



With this third and final review, we bid a fond farewell to the Sorento as it leaves the PopMech fleet with generally positive staff reviews after almost 13,000 miles of testing. Nearly every driver commented on the Kia's power; for example, this reviewer noted "a lot of giddyup from zero to whatever." But we also found that the car's muscle sometimes proved a poor match for its light steering and soft ride. That said, the Sorento performed well in a variety of weather conditions. It's a solid road-trip vehicle—smooth and quiet on the highway. As a commuter ride, this SUV also stood up well: The voice-command phone interface and sweet Infinity sound system drew positive comments, but one reviewer said the "interior ergonomics feel clumsy and cramped." But when spring yardwork season rolled around, the voluminous interior accommodated 12 bags of mulch, four bags of compost, four chunky bales of peat moss—all that, and two big standard poodles. Overall, it's difficult not to like the Sorento—a solid entry in the reasonably priced three-row-SUV category.

— JOE BARGMANN

DRIVERS NOTEBOOK

- Two PMers have reported problems with the engine stalling and the transmission acting a bit wonky, so we'll definitely get this checked out at the next oil change.
- The 200's interior was retooled last year, but we found many of the additions to be less than sophisticated, such as the manual dash clock that glows in the dark.

DATA SO FAR

AS TESTED ▶ \$19,745

PREVIOUS REPORT ▶ 04/12

MILES DRIVEN ▶ 10,953

MILES SINCE LAST REPORT ▶ 10,953

FUEL ECONOMY ▶
Average—23.9 mpg
Worst—18.9 mpg
Best—30.3 mpg

MAINTENANCE/REPAIR SINCE LAST REPORT ▶ \$101.14

DRIVERS NOTEBOOK

- The hard-shifting transmission was smoothed by a dealer-programmed software update—under warranty.
- The shift-interlock system, which holds the transmission in park, is noisy—even after the shifter was replaced.

END DATA

AS TESTED ▶ \$37,150

PREVIOUS REPORTS ▶ 01/12, 04/12

MILES DRIVEN ▶ 12,707

MILES SINCE LAST REPORT ▶ 5381

FUEL ECONOMY ▶
Average—20.0 mpg
Worst—13.1 mpg
Best—23.9 mpg

MAINTENANCE/REPAIR SINCE LAST REPORT ▶ \$35.87

OVERALL ▶ \$35.87

AUTO INTEL



Feel Like You're Defying Gravity

This is my story

I used to be more active. I used to run, play basketball, tennis; football... I was more than a weekend warrior. I woke up every day filled with life! But now, in my late 30's, I spend most of my day in the office or sacked out in front of the TV. My energy has fizzled and I'm embarrassed to admit that I've grown a spare tire (I'm sure it's hurting my love life). Nowadays I rarely walk. For some reason it's just harder now. Gravity has done a job on me.

Wear them and you'll know

But that's when a friend told me about a new kind of shoe. A shoe biomechanically engineered to make standing and walking on hard surfaces like concrete, tile and linoleum easy. They defy the force of gravity by absorbing harmful impact and propel you forward maximizing energy return. The longer he talked, the more sense it made. He was even wearing a pair himself!

Excitement swept through my body

I received my package from GravityDefyer.com and rushed to tear it open like a kid at Christmas. Inside I found the most amazing shoes I had ever seen – different than most athletic shoes. Sturdy construction. Cool colors. Nice lines... I was holding a miracle of technology. This was the real thing.

GDefy Benefits

- Absorbs Harmful Shock¹
- Have Instant Comfort
- Improve Energy Return
- Appear Taller
- Cools Feet
- Reduces Foot Odor
- Customize Your Fit
Accommodate most orthotics

Energy
without
the can!

I put them on and all I could say was, "WOW!" In minutes I was out the door. I was invincible; tireless in my new Gravity Defyer shoes.

Years of feeling exhaustion seemed to slip away. It was as if my legs had been replaced with super-powered bionics. At last, I was back in the game. Gravity has no power over me!

Customer Satisfaction
Speaks for Itself!
4 out of 5 customers purchase a 2nd pair within 3 months.

Nothing to lose:

Start your 30 Day Trial Today!

So, my friend, get back on your feet like I did. Try Gravity Defyer for yourself and live better, one step at a time.



ABSORB SHOCK
For ultimate comfort.



REBOUND PROPELS YOU FORWARD
Maximize energy return.

Semi-Rigid
Heel Stabilizing
Cage

Removable
Comfort-FitTM
Insole
Accommodates
most orthotics

VersoShockTM Trampoline
Shock-Absorbing Membrane
Heel

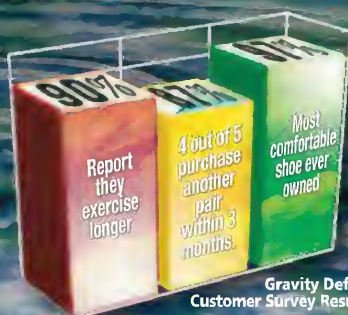
Smart MemoryTM Master Spring
Propels you forward

Twin Stabilizers

AVS³ VentilationTM Port
Cools & Reduces Microbial Growth

Rugged Polymer Sole

Resilient High Grade
Ethylene-Vinyl Acetate
(EVA) Midsole
Rocker construction
protects metatarsal bones
and aids fluid stepping
motions



\$129.95

MEN'S
TB902MBL (Black)
TB902MWG (White)
Sizes 7 - 14

WOMEN'S
TB902FBL (Black)
TB902FWS (White)
Sizes 5 - 11

WIDE WIDTHS AVAILABLE



Try a pair **FREE** for 30 Days*
SATISFACTION GUARANTEED!

GravityDefyer.com/MC8GDH6

or call (800) 429-0039

Coupon Code: **MC8GDH6**



*Shipping charges of \$14.95 billed when order ships and the order balance 30 days after. Full purchase amount is authorized at the time of transaction and requires a valid debit or credit card. Returns and exchanges must be completed in the first 30 days. See web site for complete details.



I'll Try Anything

BY JEFF WISE

PM'S REPORTER TURNED
OFF-ROAD WARRIOR
NAVIGATES THE EVER-
GLADES IN A DIY BUGGY.

The 5000-pound metal beast pitches me forward as it lurches to a stop. Eight feet below, swamp water sloshes in front of our 4-foot-high tractor tires, rousing an alligator that wriggles away for cover.



I ease the accelerator forward and begin to move, feeling my way across the submerged potholes. It's like riding a swaying, noisy metal elephant. There are reasons to take things slowly—vehicles have vanished into the sucking mud of the Everglades. "It's an extreme environment," says Gene Van Schaick, 70, the builder and owner of the behemoth I'm piloting. "It'll kick your ass."

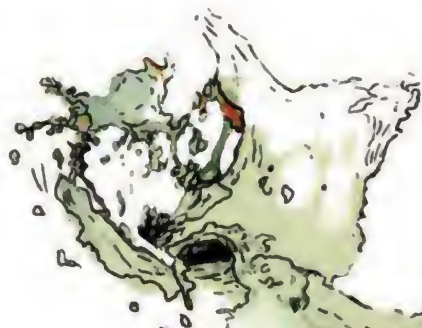
I've met up with Van Schaick to experience the landscape he loves best—the wetlands of southern Florida—aboard the machine he's most passionate about: the swamp buggy. Most Americans tend to associate "swamp" with words such as "stagnant" and "malaria" and think of swamp buggies as dirt-flinging hot rods that race up and down mud wallows. But Van Schaick's swamp buggies are slow, utilitarian vehicles, and as for the swamp—well . . . "I don't know what people think of when they trash-talk swamps," he says. "I love the swamp. I love the views. I love the smell."

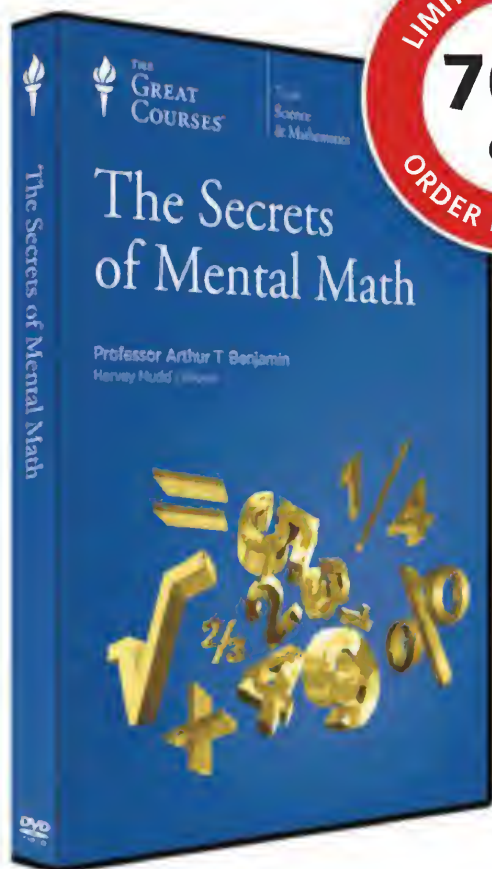
One point he'll concede: The swamp is hard to navigate. In recent geological time the area was limestone and coral reef, and it's still so flat that the torrential rains of summer and fall are slow to drain. For all but a brief dry season, waterlogged marshes and open water predominate. Anyone trying to hike in has to contend not only with the sheer physical exertion but dense vegetation, hungry alligators, clouds of mosquitoes, and four kinds of poisonous snakes.

For all its rigors, the back-country has much to offer in the way of recreation; though an easy drive from Miami, it's full of game to hunt, as well as exotic specimens to lure the bird-watcher and flora enthusiast. To tap those opportunities, intrepid Floridians began a century ago to retrofit

Model A and T Fords with big wheels and extra-low gearing. Today, a small but passionate subculture of builders—including a group founded by Van Schaick in 1990—carries on that legacy.

On a warm day in early February, Van Schaick takes me to a lot at the edge of an airstrip halfway between Miami and Naples, Fla. Some two dozen beefy, hard-driven machines are lined up, each one unique, having been designed and cobbled together—mostly out of plate metal and parts of other vehicles—by one of the 65 members of his club.





Discover the Secrets of Mental Math

One key to expanding your math potential—whether you're a corporate executive or a high-school student—lies in the power to perform mental math calculations. Solving basic math problems in your head offers lifelong benefits including a competitive edge at work, a more active and sharper mind, and improved performance on standardized tests.

In the 12 rewarding lectures of **The Secrets of Mental Math**, discover all the essential skills, tips, and tricks for improving and enhancing your ability to solve a range of basic math problems right in your head. Professor Arthur T. Benjamin, winner of numerous awards from the Mathematical Association of America, has designed this engaging course to be accessible to anyone looking to tap into his or her hidden mental calculating skills.

Offer expires 08/21/12

1-800-832-2412

WWW.THEGREATCOURSES.COM/5PRM

The Secrets of Mental Math

Taught by Professor Arthur T. Benjamin
HARVEY MUDD COLLEGE

LECTURE TITLES

1. Math in Your Head!
2. Mental Addition and Subtraction
3. Go Forth and Multiply
4. Divide and Conquer
5. The Art of Guesstimation
6. Mental Math and Paper
7. Intermediate Multiplication
8. The Speed of Vedic Division
9. Memorizing Numbers
10. Calendar Calculating
11. Advanced Multiplication
12. Masters of Mental Math

The Secrets of Mental Math

Course no. 1406 | 12 lectures (30 minutes/lecture)

SAVE \$160

DVD ~~\$199.95~~ NOW \$39.95

+\$5 Shipping, Processing, and Lifetime Satisfaction Guarantee
Priority Code: 67752

Designed to meet the demand for lifelong learning, The Great Courses is a highly popular series of audio and video lectures led by top professors and experts. Each of our more than 350 courses is an intellectually engaging experience that will change how you think about the world. Since 1990, over 10 million courses have been sold.



More bling for your buck.



Wheel Cleaner

Liquefies brake dust, grease, grime, and oil without scrubbing.



Tire Wet

Deepest shine of any other leading tire spray. America's #1 tire dressing.



Protectant

Cleans, conditions, and helps protect all interior plastic and vinyl surfaces.



Car Wash

High foaming action provides a thick foam that lasts the entire wash.

Official Shine of Carcissists.™

To bling or not to bling? That is an easy question. It's why Black Magic® has you covered, with every shine-filled product your car needs to stay glossy, inside and out.

Join the conversation at
[Facebook.com/BlackMagicShine](https://www.facebook.com/BlackMagicShine)

Available at



Van Schaick, a retired carpenter, spent six years building his behemoth, Gray Ghost. The Goodyear tires yield 27 inches of clearance. The solid-steel tie rods are behind the axle for protection against cypress knees, the club-like growths that sprout from the roots of cypress trees. (If the knee hits the axle first, it won't be able to take out the tie rods.) The engine is a 2.8-liter V-6 from a 1982 Chevy Citation, without the fuel-injection system—Van Schaick stripped it out and replaced it with a carburetor. "Everything needs to be rugged and simple," he says, "so you can fix it while standing in 3 feet of water."

Van Schaick and I clamber on top of the buggy, which, from up here, looks like a boat—fitting for a vehicle that can negotiate 6 feet of water. I fire up the engine and we head out.

Past the parking lot are 38 square miles of county-owned land. Though the landscape is nearly identical to the federally administered Big Cypress National Preserve next door, there are fewer restrictions on its use. Soon we're axle-deep in muddy water, moving across the cypress prairie. The landscape looks like something out of Dr. Seuss, an expanse of twisted gray trunks garlanded with bushy bromeliads bearing spiky red flowers. Farther on, the road becomes hemmed in by a forest so dense it feels like we're driving through a tunnel. Our wheels churn up mud the consistency of brownie batter. We never move faster than walking pace, and after an hour and a half we've covered only 5 miles.

Van Schaick takes the wheel and gives me a tour, from the high ridges and island-like hardwood hammocks that remain partially dry year-round to the sediment-filled saw-grass ponds that during the wettest months become, as he puts it, "bottomless." Van Schaick has seen lots of things in these wetlands over the years. Once he surprised a panther while on foot. "It was less than 10 yards from me," he says. "It went straight up, turned in the air, and headed the other way."

I'm surprised at how pleasant it is. There's no oppressive stench; the water in the Everglades isn't stagnant but part of a broad, slow-moving flow. Snakes and alligators thrive here; so do deer, wild hogs, and turkeys. Without buggies, much of this verdant wilderness would be all but inaccessible. "It's uncomfortable for hiking, and it's easy to get turned around," Van Schaick says. "Anyone who doesn't know the area well isn't going to be able to penetrate the interior."

Nevertheless, the machines have their detractors. "They are detrimental to the environment," says Matthew Schwartz, executive director of the South Florida Wildlands Association. "The ground is very fragile, and when you put that much weight on it, the soil doesn't recover. It erodes right down to the limestone." Schwartz's group wants to keep motorized recreation from expanding within Big Cypress. But Van Schaick counters that most of the soil eroded by swamp buggies is replenished during each yearly cycle of flooding.

As we stop at a saw-grass pond and kill the engine, we can imagine that except for the machine under our butts, there is no sign of civilization. We could be in some remote wilderness, not an hour from one of the East Coast's biggest cities. A breeze moves across the tall green stalks of the saw grass, bearing a sweetly resinous tang. Overhead, two hawks coast, circling stiff-winged on the warm air. "I love the tranquility of this place," Van Schaick says. "Apart from the buggy tracks, it's just the way it's been for hundreds of years." **PopMech**



The author in Gene Van Schaick's homemade buggy, which was constructed using plate metal, steel channel, and parts from military vehicles. It can drive through 6 feet of water.



The brightest deserves to be the center of attention.

Introducing Black Magic® Tire Wet® Spray Gel. It gives the deep, glowing shine every Carcissist™ craves. And it applies easier than other tire sprays, without leaving streaks behind. Because hassle never has to be part of the recipe for a picture-perfect shine.

Join the conversation at facebook.com/BlackMagicShine
©2012 ITW Global Brands. All rights reserved.



**The Official Shine
of Carcissists.**

Available at

O'Reilly AUTO PARTS
ADDITIONAL LOCATIONS

FOR LESS
CHECK OUT OUR WEBSITE

TechFloor™

The Easy to Install Floor Tile

Patent Pending
TwoShot™ Process



The Rubber Goes Through



Non-Slip TractionSquares™



Tile System Components



Attractive Color Options



**Snaps
Together!**



Made in USA

©2012 by MacNeil IP LLC

www.TechFloor.com
800-441-6287

MacNeil
AUTOMOTIVE
PRODUCTS LIMITED
Specialists in Original Equipment and
Aftermarket Automotive Accessories

A BONUS FEATURE FROM
THE EDITORS OF
**THE HEARST MEN'S
ENTHUSIAST GROUP***
*Car and Driver, Popular Mechanics,
and Road & Track

BECAUSE A MAN CAN NEVER HAVE TOO MANY TOOLS

THE WELL-EQUIPPED GARAGE

■

To those who love tinkering, the garage can be many things: a sanctuary, a place for quality time with your favorite toys, an alchemist's lab where beer turns ideas into reality. Whatever role the garage plays in your life, it's easy to see its potential as more than just a place to park. It calls out to be used, and to be useful. We offer the following pages as a guide to stocking your garage with the right tools, from the smallest hand-held items to the big gear that will make your neighbors jealous.



**IT'S TIME
TO RECLAIM
THE GARAGE
FROM RAKES,
BROOMS,
AND BIKES.
HERE'S
WHAT YOU
NEED TO
MAKE
IT YOURS.**

■

**CHECK THE
BOXES
NEXT TO EVERY
TOOL YOU HAVE.
THEN BUY OR
BORROW ALL
THE ONES YOU
DON'T.**

THE WELL-EQUIPPED **GARAGE**□ **DEEP SOCKETS**

Handy for nuts with tall, exposed bolts or for anything in a recessed location. You're going to be using these a lot.

□ **TORX BITS**

Like hex keys, only with a six-point design. Essential for some brake calipers.

□ **HEX KEYS**

Also known as the allen wrench, or that tool for IKEA furniture. You need a hand-held set for leverage; socket attachments are a nice plus.

□ **SOCKETS**

They'll handle every nut and bolt you'll find. Get a metric set and skimp on the fractional-inch sockets—most current cars are metric.

□ **RATCHETS**

These let you keep wrenching without lifting the socket off the bolt. The drive—the square that holds the socket—is commonly 3/8-inch, but add 1/4-inch- and 1/2-inch-drive wrenches for smaller or larger jobs, respectively.

□ **EXTENSIONS**

These give you extra length or a small bend for those hard-to-reach places.

□ **SCREWDRIVERS**

You want at least three head sizes in Phillips and slotted styles, plus short and long versions. And don't forget special heads such as Torx.

□ **NUT DRIVER**

Think of it as a socket-headed screwdriver. Often included in tool kits with interchangeable bits; you can also buy separate sets.

TOOL TIP:
6- VERSUS 12-POINT SOCKETS

A six-point wrench or socket grabs more of a fastener's sides than its corners and is less likely to round off the contact points. Twelve-points have an advantage in tight spaces where your turning angle might be limited. If you can only pick one of each, go with six-point sockets and 12-point wrenches.

**START SMALL**

Tool collecting is a journey, not a destination—you're never done hunting and acquiring. Even though the essentials displayed here comprise a broad and comprehensive set, there are tiny variations on these babies too numerous to list. Go deep into specialty tools for tasks such as engine rebuilding, and an even larger universe awaits. Our advice: Start with the basics and add to suit your budget and needs. And remember that good tools last for generations, so take a lesson from your dad and buy quality items with a guarantee.

Got toys? GET Savings.

See how much you could save on insurance for
your truck, motorcycle, RV, boat and more.



geico.com | 1-800-442-9253 | local office

GEICO®

Some discounts, coverages, payment plans and features are not available in all states or all GEICO companies. Boat and PWC coverages are written through non-affiliated insurance companies and are secured through the GEICO Insurance Agency, Inc. Motorcycle coverage is underwritten by GEICO Indemnity Company. GEICO is a registered service mark of Government Employees Insurance Company, Washington, D.C. 20076; a Berkshire Hathaway Inc. subsidiary. © 2012 GEICO



MEASURING TAPE

Measure twice, cut once, as the saying goes. Because cutting twice is just plain crazy.

WRENCH & REACH

Wrenches, like sockets, are the heroes of the tool kit—you'll use them for everything. We like combination wrenches, which have an open and a box end in each size. Nearly every bolt you see on a modern car can be turned with a metric wrench, but Imperial sizes might help with the old lawn mower.



ELBOW RATCHET

Locking, swiveling heads make them super-versatile.

PICKUP TOOL

Too lazy to bend down? Get this.

FEELER GAUGE

Use it to measure spark-plug gaps and tappet clearances. Even if you rarely use it, you'll be happy it's there.

TINY WRENCHES

Adorable but also useful.

RATCHETING WRENCHES

See inset at bottom.

HOOKS AND PICKS

Able to pick and pry where your fingers prove too fat, these usually come in a set.

MAGNETS

You need one. You will definitely drop something where it can't be reached, and one of these will save the day.

MIRROR

You can always poke around blindly, but every so often it pays to visually assess the situation.

ADJUSTABLE WRENCHES

Commonly known by the brand name Crescent, they're lauded for their versatility. A few sizes belong in every toolbox.

TOOL TIP: RATCHETING WRENCHES

With tiny ratcheting mechanisms built into the heads, they're more expensive than regular wrenches but worth it in time savings alone—to say nothing of the amount you'll save in swear-jar contributions. They're a godsend in tight spaces. Go with a small set of common sizes if you're on a budget.

NEXTGEN™

★ **BECAUSE** ★

we'd all rather
burn more rubber
than more crude oil.

50%
RECYCLED OIL



100%
VALVOLINE
PROTECTION



Introducing Valvoline NextGen. The first recycled oil formulated from a breakthrough process that combines the latest re-refining technology with Valvoline's special additives to exceed industry standards. It's the only recycled oil good enough to be called Valvoline, because we hold ourselves to a higher standard. Yours.



□ TAP AND DIE KIT

These seldom-used tools can be lifesavers.

Taps cut threads into holes; dies make threads on a bolt. You often can use them to restore cross-threaded fasteners. Failing that, just drill and tap a larger hole for a larger bolt. Most modern cars use metric threads.

□ LONG-REACH NEEDLE-NOSE PLIERS

The example pictured has a double hinge for a wider-opening angle in a narrower space.

GRIP & GRIN

Pliers grip harder than your hands can. A few basics, such as needle-nose, tongue-and-groove, and slip-joint are key. You'll be surprised how some extras, like small needle-nosed pliers, can come in handy. As for locking pliers (a.k.a. Vise-Grips), you're going to want two or three of those suckers—they're like having extra limbs.

□ LINEMAN'S PLIERS

Good for clipping heavy-gauge wire or small bolts.

□ NEEDLE-NOSE PLIERS

□ SNAP-RING PLIERS

Every once in a while, you'll come across a circular, C-shaped clip. You'll need this tool to take it off and put it on.

□ SLIP-JOINT PLIERS

Two hinge positions for double the fun.

□ DIAGONAL CUTTERS

□ NEEDLE-NOSE LOCKING PLIERS

□ LOCKING PLIERS

The Vise-Grip brand lends its name to this tool. Great for wrenching off rounded bolts, holding items still, and clamping stuff like crazy.

□ TONGUE-AND-GROOVE

Another genericized brand name: Channellock. These slide up and back for a variety of widths. You'll need at least one.

TOOL TIP:

□ HOSE-CLAMP PLIERS

Under nearly every hood is a series of coolant hoses, each with an incredibly frustrating spring clamp. This special tool mitigates the annoyance by grabbing the clamp perfectly and ratcheting precisely. A cable-operated version lets you reach into the bowels of an engine bay with ease.



CONFIDENCE.

Continental's 140 year history is rich with award-winning products, ground-breaking technologies, and a commitment to our customers that is second-to-none. WEST COAST CUSTOMS wraps everything they build in Continental Tires. Technology solutions for every generation, that's our vision. Continental Tire, continuing to drive history.



Continental is the official tire of West Coast Customs.

FOLLOW US:



go to ctposter.com, enter code PM0712 to receive a free poster & enter to win a set of tires.

ExtremeContact™ DWS

Exceptional ultra-high performance all-season tire tuned for drivers seeking extreme grip in dry, wet, and snow conditions with superior tread life and comfort.

Continental 
CONTINENTALTIRE.COM

□ LINE WRENCHES

These C-shaped, five-point-end wrenches are ideal for tightening brake lines. They slide over the line and onto a fitting.



□ BRAKE-BLEEDER TANK

The most-expensive fluid-draining solution but also one of the easiest. The tank creates a vacuum to suck brake fluid through each caliper.



□ VACUUM BRAKE BLEEDER

Another one-person way to bleed brakes, this unit requires an air compressor to provide suction.



□ BLEED BOTTLES

These are used to collect brake fluid during the bleeding process.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

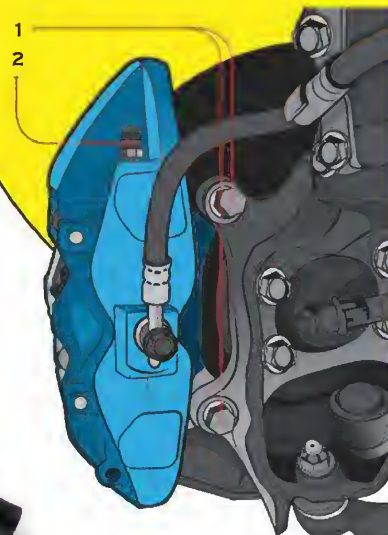
They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

They are typically made of plastic and have a one-way valve to prevent fluid from flowing back into the system.

TOOL TIP: SIZING UP BRAKES

Disc brakes look intimidating but are actually quite simple. This fixed caliper allows you to change pads merely by removing two small pins. Removing two bolts [1] allows detachment of the whole caliper. The nipple-shaped component [2] is the bleeder screw where you attach the hose to drain the brake fluid.



□ BRAKE SPREADER

The pistons in a caliper automatically compensate for pad wear. To install new full-thickness pads, you'll need to push back the pistons.



□ BRAKE SERVICE KIT

This kit typically includes various tools and components needed for brake service, such as a brake fluid, a brake master cylinder, and a brake booster.



□ BRAKE SPRING PLIERS

For attaching tricky return springs on drum brakes.



BRAKE TIME

A brake job is one of the simplest do-it-yourself auto-repair tasks, but you'll need the right tools to get it done properly. A bleeder kit and a pad spreader (or C-clamp) are essential, while other tools make the job go faster. Make sure you consult some how-to resources before your first attempt.

HAMMERS

Contrary to what you may have learned in preschool, there is a specific way to pound on everything and a different hammer for each kind of blow. Reluctant brake parts may need one of the following: 1) Ball-peen hammer for general metal-bashing and hitting punches and chisels. 2) Soft-faced hammer with replaceable heads to tap lightly on finished surfaces.

3) Rubber mallet for a light touch.

4) Drilling hammer for when serious force is needed. 5) Dead-blow hammer, filled with lead shot to reduce recoil.

- 1
- 2
- 3
- 4
- 5





The most amazing thing in this garage is parked on the ceiling.



Control your garage door and home lighting remotely with MyQ™ technology. Open and close your garage door—and operate home lighting—from anywhere in the world using your smartphone. Now you never have to worry if you left your garage door open, or how you're going to let someone into the house when you're not there. With MyQ™ technology and battery back-up protection, you're always in control.



LiftMaster®



To find your local dealer, visit LiftMaster.com

POWER UP

No, power tools are not just for lazy people. They save time and do things your hands can't. The latest cordless tools offer plenty of power and the convenience of portability. And if you stick with one brand, you can swap batteries among tools. If your drilling and grinding needs get really serious, a dedicated air-tool setup is the way to go.

□ IMPACT WRENCHES

With their internal hammers, impact wrenches dispatch even the tightest bolts. Go big for more torque or stay small for lighter weight.

□ DRILL BITS

□ CORDLESS DRILL

The essential cordless tool. If you're willing to pay extra, get lithium-ion batteries, which are lighter and recharge faster.

□ IMPACT DRIVER

This manual tool breaks stubborn screws free with a swift blow from a hammer.

□ PRY BAR

No more bent screwdrivers—this is the right tool when you need leverage. The one here has an adjustable claw.

□ CORDLESS RATCHET

Yes, they even make a cordless ratchet (it's more useful than you might think).

□ EVEN MORE POWER

Lights, saws, nail guns, and even caulk guns can be part of your cordless armory.

- 1
- 2
- 3
- 4

4 KEY COMPRESSED-AIR TOOLS

For bigger jobs requiring more torque than cordless hand-holds typically provide, you'll want to consider the following tools: 1) die grinder, 2) ratchet, 3) reciprocating saw, 4) impact wrench. Next, consider opening your own body shop.

TOOL TIP: □ IMPACT SOCKETS

You might think you can use any old socket with an impact wrench. Technically you can, but you shouldn't. Impact sockets are made of hardened steel to withstand the heavy, sudden forces of an impact wrench. Use a regular socket and you'll wear it down or, even worse, send parts flying.

Yeah, this filter **holds a lot of dirt.**



Bosch DistancePlus Oil Filters live, breathe and eat dirt. They're the only oil filters made to hold 300% more dirt and be 99.9% efficient,* providing high-performance protection for your synthetic or conventional oil. So keep your engine clean, longer, with Bosch DistancePlus Oil Filters. Bosch, the world's original equipment and innovation leader.

* Comparison based on ISO 4548-12 testing against a leading economy filter.



BOSCH
Invented for life

Get \$3 off
at boschautoparts.com

**Advance/
AutoParts**

QUEST AUTO PARTS

meijer

**PEPBOYS
=AUTO=**

and other
fine retailers

ADD THIS STUFF

From must-have items such as a torque wrench and an oil-drain pan to useful gadgets like a multimeter, there are an endless number of ways to fully equip your garage. Do it right and you'll be able to tackle almost any task life throws at you, or at least the ones that can be solved with elbow grease.

□ SOLDERING IRON

TOOL TIP: OIL-FILTER WRENCH

No matter how gently you first screw them on, oil filters are almost always a pain to remove. Which is why you need an oil-filter wrench.

Two useful styles are pliers [1], which grab hard; and swivel [2], which works well in tight spaces.

1
2

□ SCAN TOOL

Why is your "check engine" light on? It's easy to find out, and even if you can't fix it yourself, this tool will keep the mechanic honest.

□ TABLE VISE

It's like having an extra hand that is heavy and very accomplished at squeezing.

□ C-CLAMPS

□ BENCH GRINDER

Use this to clean, polish, or grind.

□ MULTIMETER

A figurative flashlight for automotive electronics, this device measures voltage, resistance, and current.

□ WIRE STRIPPER/CUTTERS

□ TORQUE WRENCH

Whether it's for properly tightening lug nuts or bolting down a cylinder head, this tool lets you dial in a precise amount of torque. Digital versions cost more but are idiot-proof.

□ KITTY LITTER

Good for spills; no substitute for an actual toilet.

□ OIL-DRAIN PAN

Think of it as a bedpan for your vehicle.

□ MECHANIC'S CREEPER

Are you working under that car or just napping? Bring your **WAND LIGHT** and **GLOVES** as an alibi.

ESSENTIAL GARAGE GADGETS

Brought to you by **amazon.com**

Now that you know what it takes to expertly equip your garage, you'll want to be sure to have the right gadgets to get your tasks done. We recommend these most essential products—a perfect mix of tools to tackle a variety of auto DIY projects.

Meguiar's Professional Dual Action Polisher



OTC Aluminum 2 Ton Jack



**Equus 3160 Diagnostic
Code Scanner**



Battery Tender Plus 12V Charger



Risk Racing Mine Light



Gorilla Automotive Torque Wrench



For these and other must-have automotive gadgets, visit the Amazon Automotive Parts & Accessories Store at [Amazon.com/automotive](https://www.amazon.com/automotive)

BONUS

THE WELL-EQUIPPED GARAGE



□ BUILT-IN CABINETS

Keep your messes out of sight. We had a neat-freak intern organize this one.

□ WET/DRY VACUUM

Hey, spills happen. No matter how nasty they get, a sucker like this cleans them up.



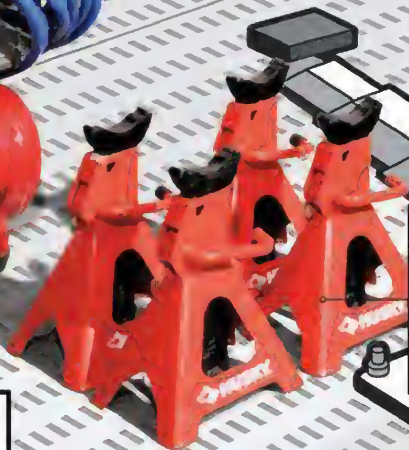
□ SMALL AIR COMPRESSOR

Great for tire inflation and small-scale air tools such as brake bleeders.



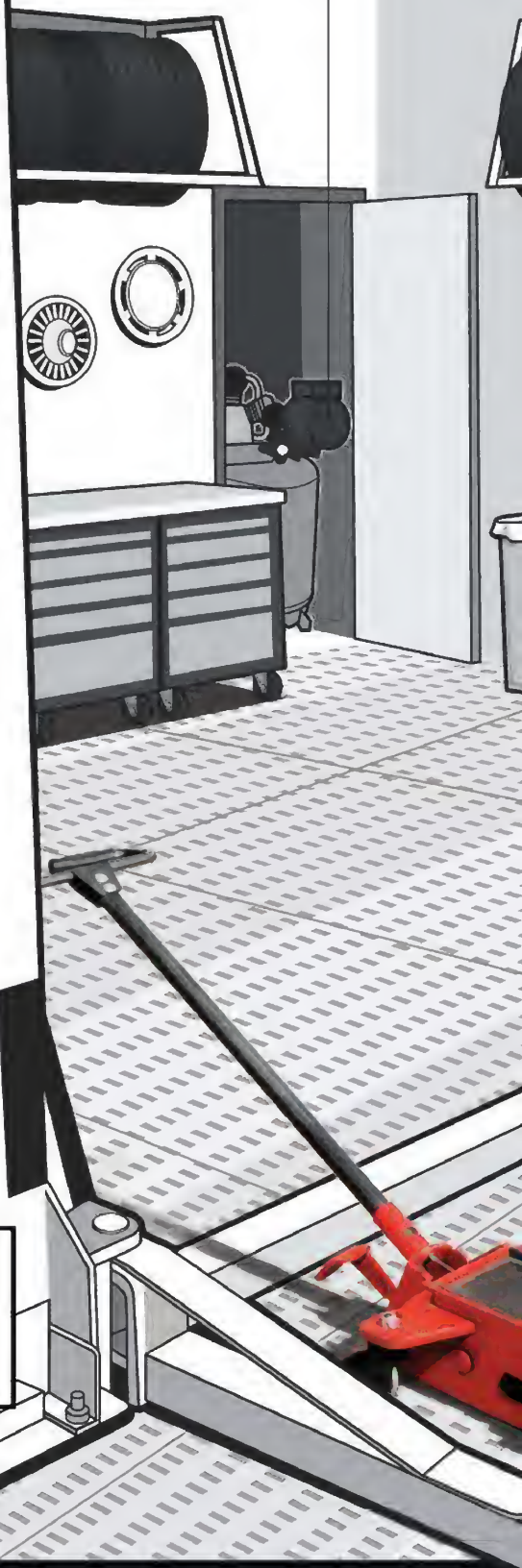
□ JACK STANDS

Leaving a car elevated with a floor jack is dangerous, and using cinder blocks is just dumb. You'll want four of these.



□ AIR COMPRESSOR

Powerful, continuous-use tools need a big one. It can be noisy, so stash it in a closet.





TIRE STORAGE

Whether they're winter tires, race tires, or just spares from the dump, hang 'em high and keep your floor space clear.

TOOL CARTS AND CHESTS

Once you have enough tools, they'll need a proper home. Smaller tool chests, such as the box on top, start at a few hundred dollars; rolling chests cost more than \$1000.

FLOORING

A good floor not only looks sharp, it also prevents spills from staining your concrete. Options range from do-it-yourself modular systems (one from MacNeil is shown above) to professionally applied coatings.

FLOOR JACK

Make sure it has at least a two-ton capacity and that it's built to last.

MECHANIC'S SEAT

Why squat when you can sit?

WELDER

The first step toward your own custom-bike-shop reality show. Don't forget the safety gear, and be nice to your dad.

DREAM BIG

If you're ambitious and dedicated, the garage can be the ultimate home-renovation project. Fill it with these big-ticket items—the rest of the details, such as wall art and beer-fridge location, are up to you. One final piece of advice: A urinal can be more useful than a sink.



THE BRIGHTEST IDEA IN WHEEL & TIRE CARE IN YEARS.

NEW Turtle Wax®
Platinum All Wheel
& Tire Cleaner
removes brake dust
and dirt instantly,
while leaving behind
a wax barrier that
makes future
cleaning easier.



Learn more at
tireandwheelhub.com.

©2012 Turtle Wax, Inc.

BONUS

THE WELL-EQUIPPED

GARAGE

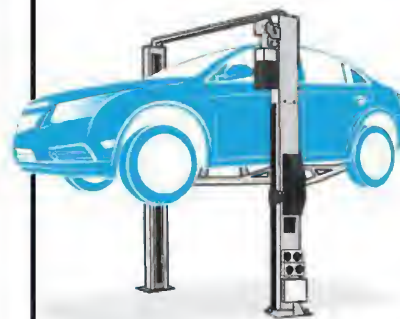
GET LIFTED

The lift is the holy grail of the amateur mechanic's garage. It makes simple tasks easier and complex tasks possible. A lift is a big deal to install; you might even need to repour your concrete floor. Here are four common styles to consider:



□ FOUR-POST PARKING LIFT

Maybe you don't have room to expand your garage, or maybe you just have a lot of cars. Either way, this lift maximizes storage space.



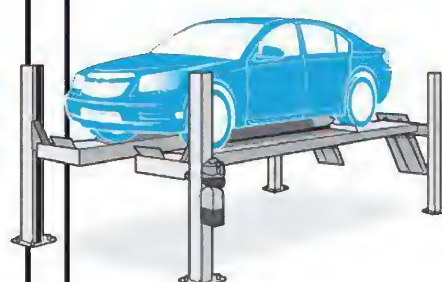
□ TWO-POST LIFT

The most common kind of lift, its arms adjust to fit a wide range of vehicles. This type leaves the wheels hanging for chassis repairs.



□ IN-GROUND LIFT

A built-in hoist offers the same functionality as a two-post lift without the structure of the posts. Installation is complicated, though, since the hydraulics are buried in the floor.



□ FOUR-POST SERVICE LIFT

Four-post lifts offer ease of use and will accommodate almost any four-wheel vehicle, plus they can be mounted on less substantial floors.

TOOL TIP: JACK POINTS

Every car has specific jack points, places underneath where the structure is designed to accommodate a lift pad or a floor jack. They're typically located between the wheels and the lower sill. Look for notches (left) or footings (right). Otherwise, play it safe by reading the owner's manual.





Keeps your car clean by repelling what makes it dirty.

New Turtle Wax® ICE® Liquid Wax does more than protect your car. Unlike conventional waxes, it repels dirt for a like-new brilliance that lasts. The enhanced resins and protective polymers in ICE Liquid Wax create the new hard-shell finish that keeps your car cleaner, longer. turtlewax.com/ice

©2012 Turtle Wax, Inc.

**Turtle
WAX**

THE SMARTER WAY TO SHINE.™

Looking Downrange

///

You think you know special operations—teams of gunslingers who launch midnight raids against terrorist camps, blow up bridges, or call in covert airstrikes. But the traditional role of spec ops is training foreign soldiers and building stable nations, skills that will be put to the test as the U.S. withdraws from Afghanistan. PM rides with an A-Team as it prepares to guard America's exit from its longest war.

By
Joe Pappalardo ///

Photographs by
Chad Hunt





PM spent a week with operators in Washington state as they prepared for deployment to the Middle East. Handling armored trucks is one of dozens of skills they must learn.



46° 45' 40" N
120° 11' 29" W

D

DAWN IS BREAKING AS SIX MEMBERS OF the A-Team gather for physical training (PT) at an empty trailhead in Yakima, Wash. The men, dressed in MultiCam desert camouflage, deploy from a white government-issued van and immediately start unloading rucksacks and doing leg stretches.

Only half of the 12-man detachment, part of the 1st Special Forces Group, is available to stalk Rattlesnake Hills on the edge of the city for this morning's PT. One member is injured, another is in sniper training, and the team's Fox (intelligence specialist) is in dive school. The rest are sleeping off the prior night's guard duty at the Yakima Training Center. The clandestine operational detachment is a long way from its home base at Okinawa. The wide, undulating landscape and relentlessly rocky terrain here more closely resemble Afghanistan, where the team is slated to spend 2013.

The men shrug on 30-pound rucks and wordlessly start the brisk march. Boots crunch on gravel in an increasing cadence. The detachment's Alpha (commander) is a 29-year-old captain, a combat veteran who served in the infamously violent Korengal Valley in Afghanistan while with the conventional Army. His Zulu (senior nonenlisted) is a 37-year-old master sergeant; this team has no warrant officer, so the Zulu is second in command. Since this A-Team is readying for a deployment—they call it going downrange—their real names cannot be used. Special operations forces (SOF) value secrecy above everything except physical fitness.

The team's leaders call out a word of warning: No running allowed. "If one starts, they'll all try to be first," Alpha says. "We all have Type-A personalities on this team."

The trail winds steadily upward, past a handful of isolated ranch homes. As soon as the team sees an opportunity, the members leave the semipaved road and ascend a steep hillside matted with rocks and ankle-high tangles of scrub brush.

The team's senior Echo (communications specialist) pauses to admire the view. He's a sergeant first class with 15 years of experience in the military, including work as a scout and sniper in the conventional Army. His shoulders are broad and so is his grin. He smiles a lot. Yakima never looks better than it does from the crest of a hill at dawn, city lights still glittering under a recently risen sun. "Kinda makes getting up at oh-five-hundred worth it," he says.

A civilian four-wheel all-terrain vehicle is unexpectedly waiting for the team as it finishes zigzagging down the slope. The homeowner

SPECIAL OPS' GLOBAL SCOPE

01

YEMEN

DIRECT ACTION:

Airstrikes

OBJECTIVE: Hunt members of al-Qaida in the Arabian Peninsula who are seizing towns and attacking government officials.

UPDATE: Special Operations Command (SOCOM) and the CIA pick targets for drone and manned aircraft attacks against al-Qaida leadership and clusters of fighters. The website Long War Journal estimates that 23 strikes have been carried out since December 2009.

02

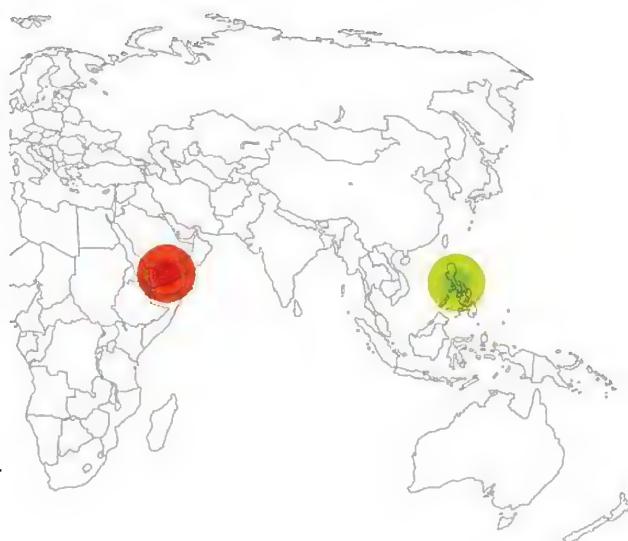
PHILIPPINES

INDIRECT ACTION:

Foreign Internal Defense

OBJECTIVE: SOCOM deployed to the island of Basilan to counter gains made by the Islamist insurgent group Abu Sayyaf.

UPDATE: A 500-man spec ops task force trains local military units to take and hold ground from Abu Sayyaf. Since the mission's inception in 2002, 17 U.S. service members have died while advising and assisting Filipino forces.



46°45'40"N
120°11'29"W

WAR WAGON: The Army has more than 8000 Mine-Resistant Ambush-Protected-All-Terrain-Vehicles [M-ATVs] for use in Afghanistan. Special operations forces received 460; Oshkosh modified the vehicle to suit SOF needs.



TRUNK MONKEY

The cargo area of a spec ops M-ATV can be accessed through a hatch in the cab. A mounted weapon covers the blind spot behind the vehicle. The cargo area can handle a variety of communications and other spec-ops-specific hardware.

CROWS' NEST

A common remotely operated weapon station (CROWS) sits on the top of all spec-ops-modified M-ATVs. The system accommodates a variety of machine guns that can be fired from inside the vehicle. A gunner can zoom in on targets with the day/night optics and fire using a joystick.



SITUATIONAL AWARENESS

Special Operations Command requested a larger windshield so drivers would have better awareness of what's outside the vehicle.



driving it quickly endorses the men's presence in a polite hearts-and-minds moment. "It's okay, if it's you guys," he says. "I have to come out and check on people, since methheads and hookers come up here to do their business sometimes."

It's considered a light morning of PT; a more typical start to the day consists of a 90-minute run (not including forward and backward sprints up the inclines and a slate of leg-burning squat thrusts) and the first of two daily free-weight workouts. But the next few days and nights at the Army training center will be crammed with lessons in operating vehicles they have never driven before. A brief hike will have to do.

Alpha's men will be among the nearly 10,000 special operators in Afghanistan in 2013, preparing for the administration's 2014 exit of major combat troops. "While the aggregate number of total personnel in Afghanistan will decrease as we approach 2014, the special operations forces' contribution may increase," Adm. William McRaven, head of Special Operations Command (SOCOM), told Congress in March. They will be there until at least 2017.

The expectation in Washington, D.C., is that these teams can take the lead in keeping the Afghan central government in control of a dysfunctional country of 35 million. If they can, America's longest war will end with a qualified win. If they fail, the nation could slip into civil strife and again become a haven for terrorists. "The rumbling around town is that special operations forces will basically own the U.S. mission in Afghanistan," says Travis Sharp, a fellow at the Washington, D.C.-based Center for a New American Security. "SOF has been on the rise for a decade. Now we are going to see if they can hold and consolidate gains." He adds: "If I trust anyone to get the job done, it'd be SOF."

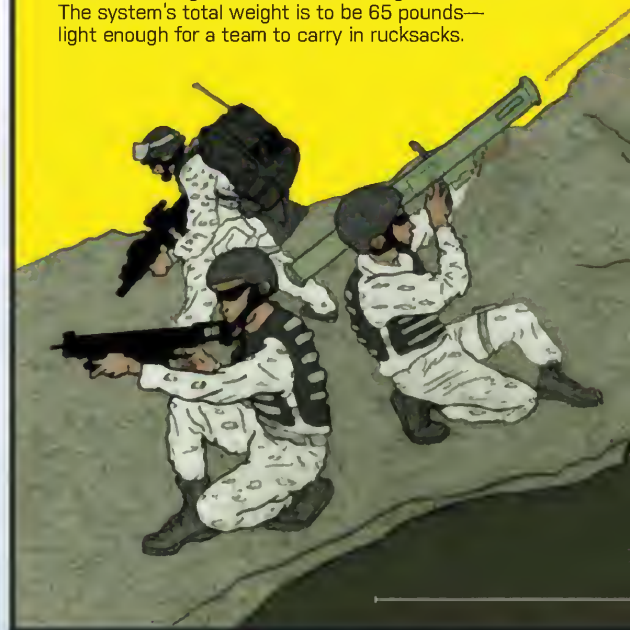
Although Pentagon planners are finishing this war with a geopolitical Hail Mary pass, at least they are relying on the right players. Special operations A-Teams are made of incredible individuals with an action hero's résumé of skills: para-jumping, foreign-language fluency, a professional athlete's physical conditioning, and familiarity with an entire catalog of

Spec Ops Gear: WHAT THEY WANT

OFFICIALS AT SPECIAL OPERATIONS COMMAND IDENTIFIED WEAPONS TECHNOLOGIES THAT THEY WOULD LIKE TO FIELD IN UPCOMING YEARS. THEIR WISH LIST SHEDS LIGHT ON THE MISSIONS THAT OPERATORS CONDUCT.

01 DIY AIRSTRIKES

There are times in an operator's career when close air support or heavy artillery is not available and a target must be eliminated from a distance. In 2011, SOCOM asked industry for a missile system capable of striking enemy personnel, moving vehicles, and light structures at a range of 9 miles. The system's total weight is to be 65 pounds—light enough for a team to carry in rucksacks.



Most of this A-Team has conventional Army experience in Iraq or Afghanistan and has done spec ops counter-insurgency work in the Philippines and Iraq.

vehicles and weapons. And then there are the specialties: construction and demolitions, communications, intelligence gathering, and battle-field medicine verging on internal surgery.

These dedicated, sincere men are setting out to tame a land of suicide bombing, systematic abuse of women, and legendary duplicity. They are high-value individuals deploying to a place



02 NEW TOOLS FOR SNIPERS
Flatter trajectory rounds for 7.62-mm, .300 Win Mag, .338-caliber, and .50-caliber sniper rifles will not only make the weapons more accurate but will enable them to hit targets with more kinetic energy at extreme ranges. Another request is for a sniper rifle that can be broken down into a clandestine package.

03 NONLETHAL GRENADES
SOCOM requested industry solicitations for a new kind of 40-mm low-velocity grenade that can dispense liquid or gas into a vehicle or vessel without harming the individuals inside.

04 BETTER MASKING FOR RIFLE SHOTS
SOCOM is seeking integrated suppressors for rifle barrels that can hide infrared and thermal signatures when the weapons fire—rendering them invisible to opponents' night-vision goggles. These devices need to work despite the weapon's recoil and changes in its barrel temperature.

18



46° 45' 40" N
120° 11' 29" W

HOW IT WORKS

- 1 A SPOTTER HIDDEN ON A HILL PAINTS THE TARGET WITH A LASER.
- 2 NINE MILES AWAY, THE TEAM FIRES THE MISSILE.
- 3 GPS COORDINATES GUIDE THE MISSILE AS IT STREAKS TOWARD THE TARGET.
- 4 THE SPOTTER'S LASER GUIDES THE MISSILE ON ITS FINAL, OR TERMINAL, STAGE FOR A DIRECT HIT.

9 MILES

where human life has little value.

During the ruck march, I remark to Zulu that my backpack weighs about 20 pounds less than his. I recycle a line from a *Dirty Harry* movie to explain my minimalist packing: "A man's got to know his limitations." The 37-year-old Zulu shoots me a skeptical look. "Oh, really?" he says. It's clear I have spoken heresy. Admitting something can't be done is not in these guys' DNA.

THE SOFT SIDE OF SPECIAL OPS

When most people think of special operations, they think of lightning-fast raids that target terrorist leaders. The killing of Osama bin Laden was the capstone on a decade of aggressive wartime missions that the military calls direct-action, or kinetic, missions. Although presidents have virtually no control over the planning or execution of these missions, they can be elected or booted from office based on their outcomes. Just ask Jimmy Carter, who signed off

on an ill-fated hostage rescue in Iran.

Direct action, with its associated stealthy recon, building breaches, helicopter repelling, and double-tap gunshots—fits a violent stereotype of spec ops that does not match the reality. SOCOM has another mandate: to prepare other nations to take care of themselves. "The selection process is very good at weeding out anyone who only wants to shoot people in the face," Alpha says. "We need warrior-politicians."

These "indirect-action" missions include training foreign troops and teaching locals how to establish responsible governments. The strategy also promotes economic development by building bazaars, encouraging farmers to grow extra food crops to sell, and constructing roads. No one makes video games based on indirect-action missions.

The public may not have a good grasp on SOCOM's activities, but Washington, D.C., is increasingly relying on its broad mandate to counter global instability. Since 2001, SO-



46° 45' 40" N
120° 11' 29" W

This team has less than a year to prepare for deployment to Afghanistan. The operators are prepared to fight, but the emphasis is on building a local force to repel insurgents: One day is spent on mortar training, six weeks on learning the Pashto language.

COM's ranks have doubled and are funded to grow from 66,100 to 71,100 by 2015. Its budgets tripled since 2001 to a 2012 tally of \$10.5 billion. The tempo of deployments has risen too: the command's personnel (not all A-Teams) now work in at least 75 nations, 15 more than the total at the end of the Bush administration. "I expect the operational demands placed on special operations forces to increase across the next decade and beyond," McRaven says.

SOCOM has become the U.S. government's tool of choice for soft power projection, but this is partly by default. "Most of our resources, when it comes to these types of efforts, are placed in the Department of Defense," says Rick Nelson, a senior fellow with the Center for Strategic and International Studies, who served with Joint Special Operations Command. "The reality is that the State Department and USAID are not funded at appropriate levels."

Spec ops has become a tempting option for civilian policymakers. Teams are easy to send into the field because they can be deployed with little disclosure to the public or to regional allies, minimal advance warning, and fewer bureaucratic approvals. "The U.S. government is at risk of seeing SOF as a panacea for all of America's security problems in the world," Travis Sharp says. "There is a reasonable limit to what they can accomplish and remain sustainable."

The nation-building aspect of SOCOM's work is increasing as the war efforts recede and kill/capture raids become rarer. But those who assist SOCOM—Congress, which pays, and conventional forces, who contribute airlift, bases, and support personnel—may not be eager to aid the kinder, gentler SOCOM missions.

"The spotlight has been on the kinetic operations against high-value targets," says Adm. Eric Olson, former head of SOCOM. "Everybody lines up to support those, with a full capability and budgets." His concern is that as SOF leave battlefields, the smaller, less violent operations won't get the attention they need: "Instead of having the spotlight on special operations forces shift, I think it will just dim."

ECHO ON WHEELS

The senior Echo is behind the wheel of a \$470,000 mine-resistant all-terrain vehicle, wearing his helmet, communications headset, and trademark grin. He's never driven an M-ATV without an instructor before today, but there's no hesitation as he maneuvers the 32,000-pound behemoth across a mat of scrub brush at the Yakima Training Center. "Real men drive big trucks," he says over the rumble of the idling 370-hp engine. "As long as they're diesel."

The M-ATV is fun to take off-roading, but spec ops guys don't like them because they are loud and intimidating. Riding into a village in such a vehicle violates some of the core tenets

03

LATIN AMERICA

INDIRECT ACTION: Foreign Internal Defense

OBJECTIVE: Promote military relationships with an annual competition, Fuerzas Comando.

UPDATE: Commandos from 19 countries participated in the 2011 competition. Events included a timed 11-mile forced march, sniper contests, and a combined airborne operation. U.S. troops placed sixth; El Salvador took first place.

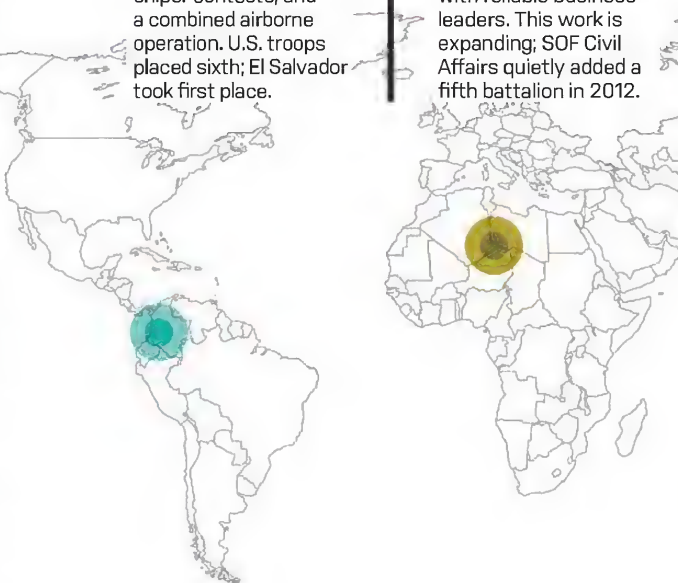
04

TRANS-SAHARA

INDIRECT ACTION: Civil-Military Support Element

OBJECTIVE: CMSE teams advise local governments on how to meet the needs of at-risk populations.

UPDATE: CMSE teams from the 91st Civil Affairs battalion provide veterinary services, construction, and partnerships with reliable business leaders. This work is expanding; SOF Civil Affairs quietly added a fifth battalion in 2012.



83

46° 45' 40" N
120° 11' 29" W

LOOKING DOWNRANGE

POPULARMECHANICS.COM

JULY 2012

of the team's mission: Use what the locals have; project confidence; stay alert and maneuverable; relate on a human-to-human basis. "On a mission," Alpha says, "I'd just as soon walk."

But this is special operations, and the M-ATV has been modified to meet SOCOM's demands. The windshield is wider, and there is a hatch in the back to allow a crew member (dubbed a trunk monkey) to man a mounted weapon. These M-ATVs also have a common remotely operated weapon station (CROWS) affixed to the roof. With it, a gunner in the back seat can scan the surroundings with the system's day/night optics and use a joystick to fire the machine gun at whatever's in the onscreen crosshairs.

The team uses two M-ATVs to practice an off-road advance called a bounding overwatch. One truck remains still, scanning for threats with the CROWS, as the second rolls through the scrub brush. When the M-ATV in motion finds a place with a good view, it stops, and the first

From:
Ship Date:
Master No.:

[US]



Ref. Code

SO YOU WANT TO BUY AN...

ULTRA-BOOK

by Glenn Derene and
Anthony Verducci

This well-organized mess of electronic parts used to be a beautiful Samsung Series 9 [\$1400].

When Apple launched the wafer-thin MacBook Air in 2008, it seemed like an expensive, underpowered novelty. Now, superlight computers have hit performance parity with traditional laptops and prices have plummeted, with the rest of the PC industry hopping on the ultrabook bandwagon. What do you need to know before you buy? Let's look inside.

- 1 Screen** The monitor determines the size and weight of the computer. To keep ultrabooks slim, manufacturers typically laminate LCD screens in place without a glossy protective top layer.
- 2 Battery** Open an ultrabook and you'll see that half the real estate is occupied by a battery. These PCs can run 5 to 7 hours on a charge—accept nothing less.



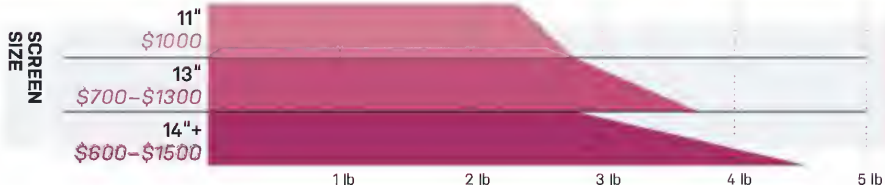
1

2

DIAGRAMS BY LANA BRAGINA



Know what
you want



3 Unibody chassis When you build something this thin, rigidity becomes an issue. Look for a firm metal (aluminum or magnesium) structure. Avoid plastic chassis, which can bend or break.

4 Ports Prepare to make do with fewer of these. Ultrabooks have no optical drive and rarely more than two USBs (make sure at least one is USB 3.0), plus an SD card reader. At the 11-inch size, you often lose the SD, too.

5 Wi-Fi Unless you want to carry around a USB or proprietary Ethernet dongle, the built-in Wi-Fi card is your only path to the Internet—most ultrabooks have no built-in Ethernet jack.

6 CPU The ultrabook's secret ingredient is a low power processor with integrated graphics. Newer PCs should be using Intel's Ivy Bridge CPUs, which stretch battery life and improve video performance.

7 RAM In a typical computer, RAM is the most user-upgradable part. Not in ultrabooks. The RAM is soldered to the motherboard, so plan for the future by buying a machine with at least 4 GB.

8 Hard Drive Most ultrabooks use solid-state drives (SSDs) in the new mSATA format—essentially, that's a small circuit board with flash memory on it. SSDs are speedy, but capacity is low.

INSIDE THE PM LAB

To take apart this ultrabook, we had to remove dozens of miniature screws. We counted 74 tiny 0.064-inch screws in the keyboard alone.

—ANTHONY VERDUCCI



PROCESSOR	Intel i3	Web surfing, music, photos, documents, movie watching
	Intel i5	Video transcoding, light video and photo editing
	Intel i7	Complex video editing, gaming

HARD DRIVE CAPACITY

13,000 MP3s
OR
19,000 pictures
OR
21 HD movies
64 GB

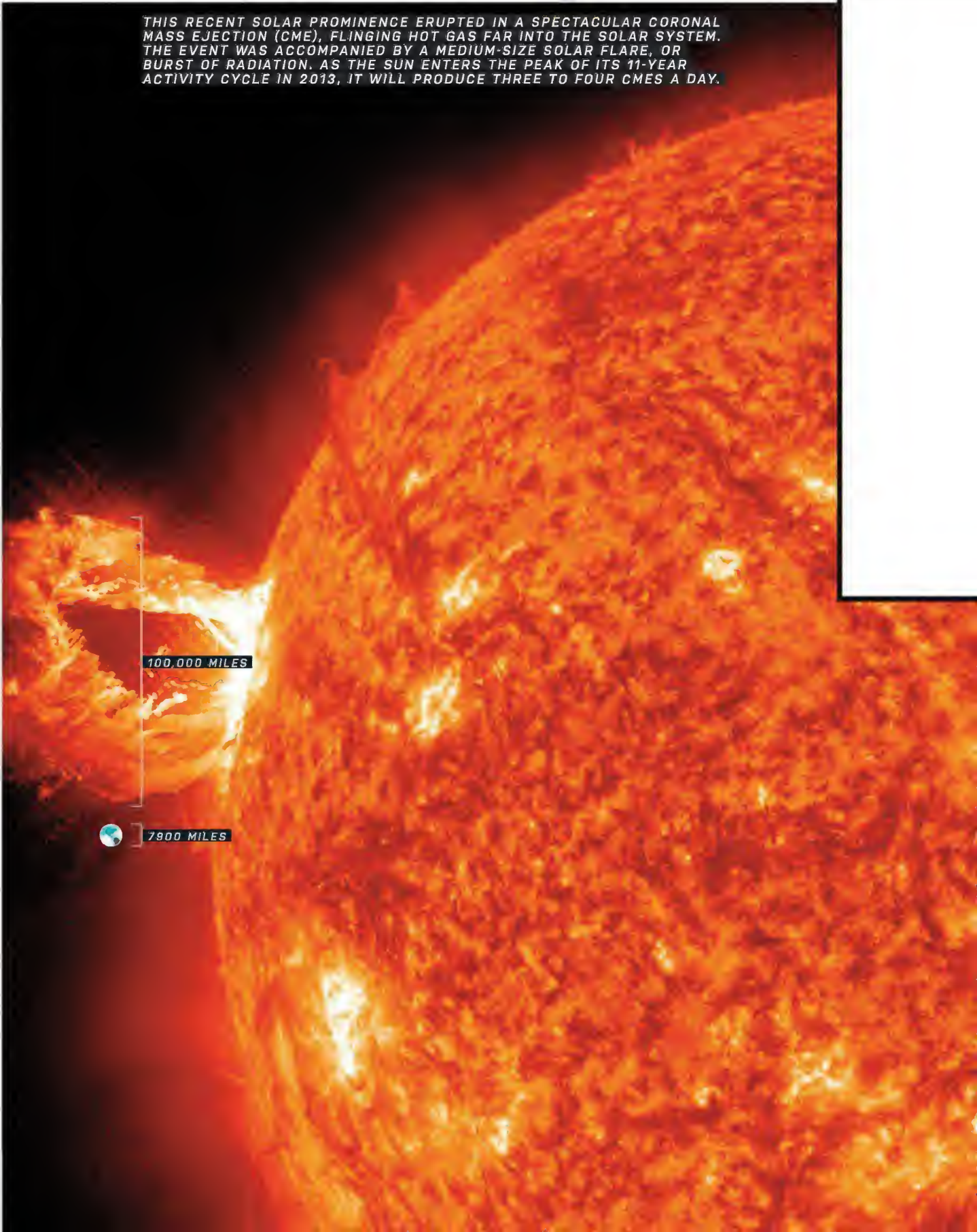
26,000 MP3s
OR
33,000 pictures
OR
43 HD movies
128 GB

52,000 MP3s
OR
86,000 pictures
OR
85 HD movies
256 GB

SOURCE: NASA'S SOLAR DYNAMICS OBSERVATORY ■

■ 04/16/2012

THIS RECENT SOLAR PROMINENCE ERUPTED IN A SPECTACULAR CORONAL MASS EJECTION (CME), FLINGING HOT GAS FAR INTO THE SOLAR SYSTEM. THE EVENT WAS ACCOMPANIED BY A MEDIUM-SIZE SOLAR FLARE, OR BURST OF RADIATION. AS THE SUN ENTERS THE PEAK OF ITS 11-YEAR ACTIVITY CYCLE IN 2013, IT WILL PRODUCE THREE TO FOUR CMES A DAY.



100,000 MILES



7900 MILES

Welcome to the new solar maximum

BY LEE BILLINGS

The sun has been hurling plasma at Earth for billions of years, but the next direct hit could damage power grids and other infrastructure—immobilizing the technology that underpins civilization.

F

FOR MORE THAN a week, NASA officials cautiously watched as vast plumes of material, tens of millions of degrees Fahrenheit, arced from the far side of the sun. Then the culprit spun into view: a region of sunspots more than 13 times the diameter of Earth, bubbling with volatile magnetic fields. Around 7 am Eastern time, the region erupted, releasing a pulse of hot, electrified gas that shot toward the planet at millions of miles an hour. It was Oct. 28, 2003, and in the Service Module of the International Space Station, astronaut Michael Foale and cosmonaut Alexander Kaleri had just downed coffee as they prepared for the first full workweek of their 195-day mission. The station's orbit was

sweeping the craft toward the South Atlantic Anomaly, an area above the eastern coast of South America where high-energy particles from the sun become concentrated.

Mission control called, Foale remembers. "They said, 'Hey, we've got some big events coming. We recommend you shelter in your crew station, Mike.'" With the radiation units on his personal dosimeter ticking upward, Foale floated 200 feet down two long tunnels to his sleeping quarters near the front of the station. He closed himself in the coffin-like room, lined with thick polyethylene foam bricks to shield his body from the protons flying through the station—the product of one of the most powerful solar flares ever recorded. Outside, the craft glided through a curtain of brilliant green light—an aurora, created by electrons colliding with oxygen in Earth's atmosphere. "It was very dramatic and quite spectacular," Foale says. But to be enveloped in that energy is unsettling. "Obviously you think, this is not good," he says.

At 7:30 am, a satellite stationed between the sun and Earth observed the star gain an ominous halo, the telltale sign of a coronal mass ejection (CME). The billion-ton belch of magnetized plasma reached the planet the following morning. It slammed into Earth's magnetic field, which vibrated like a bell, and in a manner analogous to a moving bar magnet raising currents in a coil of wire, the CME sent powerful electric currents coursing through the planet. Those ground currents flowed into power lines; electric grids around the world strained. In North America, utility companies scaled back generation. In Sweden, a high-voltage transformer blew, blacking out the city of Malmö for almost an hour. The barrage of solar particles continued for days, interfering with satellites and radio communications; auroral lights danced across the sky as close to the equator as Florida and Australia. Roughly a week later, the sun's most active regions rotated out of alignment with

the planet. No lives were lost, but the storm had caused many hundreds of millions of dollars in damage.

The sun's activity roughly follows an 11-year cycle, and severe space weather tends to cluster around each cycle's peak. The sun is now entering the peak of Cycle 24, as evidenced by powerful solar storms it unleashed in January and March of this year. Those storms had little effect on Earth, largely due to chance: The orientation of the planet's magnetic field caused much of the radiation to slide over it. The next big CME will test that luck.

This deeply worries John Kappenman, founder of Storm Analysis Consultants and an expert on the effects of geomagnetic storms. His detailed investigations of the so-called Halloween Storm of 2003 found that it, too, had been dampened by the alignment of Earth's magnetic field. And yet it still blacked out an entire city and stressed continental power grids. If the planet had absorbed the full brunt of the CME, the blackout could have had far more severe repercussions. "If you lose electricity, within a matter of days you essentially lose almost everything else," Kappenman says. "After the initial blackout, we wouldn't really understand the seriousness of the situation until several days went by without having things restored. We'd rapidly lose the ability to provide the necessities for modern society."



THIS MAY SEEM like doom-saying, but the historic record suggests otherwise: The Halloween Storm, in fact, appears minor compared with several earlier events. In March 1989, a geomagnetic storm knocked out a high-voltage transformer at a hydroelectric power plant in Quebec, plunging the province into a 9-hour blackout on an icy winter night. A storm that enveloped Earth in May 1921 sparked fires in telegraph offices, telephone stations, and railroad routing terminals connected to nascent power grids. The most extreme observed storm of all, called the Carrington Event, occurred in

"The physics of the sun and of Earth's magnetic field have not fundamentally changed, but we have. We decided to build power grids, and we've progressively made them more vulnerable as we've connected them to every aspect of our lives."

— John Kappenman,
Storm Analysis
Consultants



September 1859: It caused geomagnetic currents so strong that for days telegraph operators could disconnect their equipment from battery power and send messages solely via the "auroral current" induced in their transmission lines.

"The physics of the sun and of Earth's magnetic field have not fundamentally changed, but we have," Kappenman says. "We decided to build power grids, and we've progressively made them more vulnerable as we've connected them to every aspect of our lives. Another Carrington Event is going to occur someday." But unlike in 1859, when the telegraph network was the sole technology threatened by space weather, or in 1921, when electrification was in its infancy, today's at-risk systems are legion.

Over the past 50 years, global power-grid infrastructure has expanded tenfold. Meanwhile, utilities have shifted to higher operating

voltages, which increase the efficiency of electricity transmission but make equipment less resistant to unregulated ground currents. As the grid has grown, so too has the practice of importing and exporting electricity between regions and even countries: A streetlight in upstate New York may be powered by a hydroelectric plant in Quebec; a neon sign outside a Tijuana nightclub may glow because of a natural-gas plant in Southern California. This interdependency increases the risk of widespread collapse. Humans have effectively created

continent-size antennae—all exquisitely tuned to soak up currents caused by space weather.

Over the years, Kappenman has undertaken a series of studies underwritten by various branches of the federal government. He has consistently found that a great geomagnetic storm, striking with little forewarning, would overheat hundreds or thousands of high-voltage transformers in the U.S. grid, melting crucial components and effectively crippling generation capacity. Building replacement transformers at current production rates would take up to 10 years, during which time more than 100 million people would be without centrally provided power. This would cost the economy an estimated \$1 trillion to \$2 trillion in the first year alone.

Last year the Department of Homeland Security asked an independent group of elite scientists, the JASON Defense Advisory Panel, to analyze Kappenman's claims. In its November 2011 report, the panel expressed skepticism that his worst-case scenario could occur but agreed that the U.S. power grid could suffer severe damage from a geomagnetic storm. The scientists called for more

How a Solar Storm Works

During a coronal mass ejection, the sun violently blasts high-energy particles traveling several million miles an hour into space. When these particles sweep into Earth's magnetosphere a day or so later, they set off a geomagnetic storm.

1 High-energy protons and electrons pass through spacecraft such as the International Space Station, damaging electronics and degrading solar arrays.

2 They also heat and expand the upper atmosphere, which increases **drag on satellites**, reducing their lifetimes in orbit.

3 Earth's ionosphere becomes distorted with radiation, and plasma bubbles form. **GPS signals scintillate, or break up**, as they pass through this region, disrupting the triangulation of points necessary for precise navigation.

4 Ionized particles also affect the propagation of radio waves. Airplanes flying above 85 degrees latitude rely exclusively on high-frequency radio communications, and so may be rerouted.

5 Vibrations in Earth's magnetic field induce strong electric currents in the ground. These follow the path of least resistance **into oil and gas pipelines, causing corrosion.**

6 They also flow into power-grid infrastructure such as transformers, which can blow out from the sudden burst of unregulated current.



92 MILLION MILES

1.5 MILLION MILES

Sun Spotters

A handful of satellites keep instruments trained on solar activity, detecting radiation storms hurtling toward Earth. Half could fail at any time. — *Dalene Rovenstine*

Solar and Heliospheric Observatory (SOHO)
Planned Mission
Length: 2 years
Launch: Dec. 2, 1995

SOHO uses its extreme ultraviolet imaging telescope to generate high-resolution images of the sun's corona and predict space weather in real time. NASA lost connection with SOHO for six weeks in 1998; the satellite now operates without a gyroscope for maintaining orientation.

Advanced Composition Explorer (ACE)
Planned Mission
Length: 5 years
Launch: Aug. 25, 1997

The satellite is equipped with six high-resolution spectrometers and three instruments that study solar wind and high-energy particles accelerated by the sun. After 15 years in space, ACE can still provide about an hour's advance warning of geomagnetic storms.

Solar Terrestrial Relations Observatory (STEREO)
Planned Mission
Length: 2 years
Launch: Oct. 26, 2006

The two satellites in the STEREO mission study coronal mass ejections, leading to more accurate alerts for solar flares. The crafts reached a major milestone on Feb. 6, 2011: achieving 180-degree separation, which allowed a 360-degree view of the sun for the first time ever.

Solar Dynamics Observatory (SDO)
Planned Mission
Length: 5 years
Launch: Feb. 11, 2010

SDO's suite of instruments provides insight into how the sun's magnetic field is generated, structured, and converted into violent solar events—at near-IMAX-quality resolution.

Geostationary Operational Environmental Satellites (GOES)
Planned Mission
Length: 10 years
GOES-13 Launch: May 24, 2006
GOES-14 Launch: June 27, 2009
GOES-15 Launch: March 4, 2010

Besides keeping a steady eye on Earth, GOES-15—equipped with a solar X-ray imager, a solar X-ray sensor, and an extreme ultraviolet sensor—helps NOAA forecast space weather too. GOES-13 backs up 15 during eclipses; however, its X-ray sensor is not reliable. GOES-14 is orbiting in storage mode until needed.

NOT TO SCALE

space-weather safeguards, including hardening electrical infrastructure and bolstering the nation's aging network of sun-observing satellites.

Physicist Avi Schnurr, who presides over the nongovernmental Electric Infrastructure Security Council, is among those doubtful that modern society will successfully address the problem. "If a Carrington Event happened right now it probably wouldn't be a wake-up alarm—it would be a good-night call," he says. "This is a case where we have to do something that is not often successfully achieved by governments, and certainly not by democracies: We have to take concerted action against a predicted threatening event without having actually experienced the event itself in modern times."

Protecting the grid is, in principle, relatively straightforward. Most

high-voltage transformers connect directly to the ground to neutralize power surges from lightning strikes and other transient phenomena—but that also allows geomagnetic currents to flow upward. Experts estimate that electrical resistors or capacitors, which would sever that connection, could be installed at critical locations (such as near power plants or major cities) within a few years. In practice, however, it's not so easy: U.S. power companies have balked at voluntary installation of such devices, which could cost about \$100,000 per transformer.

Peter Pry, a former Central Intelligence Agency official and staff member on the U.S. House Armed Services Committee, has tried to spur legislative action on the threat of space weather. He has also watched in frustration as bills mandating protection of the grid repeatedly went nowhere. "The real danger here isn't astrophysical, it's institutional," he says. "The threat to everyone belongs to no one."



THE FIRST LIGHT OF NASA'S SOLAR DYNAMICS OBSERVATORY SHOWN AT A PRESS CONFERENCE ON APRIL 21, 2010.



POWER OUTAGES wouldn't be the only cause of cascading failures in the event of extreme space weather. Jane Lubchenco, head of the National Oceanic and Atmospheric Administration (NOAA), points out that highly charged particles can also degrade the precision of GPS satellites. Signals from these networks allow receivers to calculate geospatial positioning and measure time to billionths-of-a-second accuracy. Besides providing directions for road trips, they synchronize cellphone conversations, orchestrate air traffic, and guide fleets of emergency vehicles.

"Today, most financial transactions are date-stamped with GPS, and GPS guides the dynamic positioning of most deep-ocean oil and gas operations," Lubchenco says. "Can you imagine the financial disruption that a GPS outage would cause? Can you imagine the Deepwater Horizons that would occur if drilling platforms

received erroneous GPS information?"

For now, the only way to ensure that power grids and satellite networks withstand another Carrington Event would be to preemptively shut them down when a big storm is likely to occur. "That's really not a good solution," Kappenman says. For one thing, each self-enforced outage would cost billions of dollars in lost productivity. For another, he says, "forecast systems probably aren't ever going to be precise enough to avoid false alarms."

Thomas Bogdan, former director of NOAA's Space Weather Prediction Center in Boulder, Colo., acknowledges "our ability to forecast is actually fairly poor." CMEs and solar flares will be particularly difficult to predict without better theoretical models of the circulation of plasma in the sun, but CMEs reliably occur three or four times a day during our star's activity peak, and approximately once a week during solar quiescence. "The only reason we really get by is that the sun has a regular activity cycle," Bogdan says.

The prediction center relies on constant surveillance of the sun for the slightest indication of a threatening event. Initially, this comes from ground-based observatories operated by the U.S. Air Force and a NOAA satellite network watching for the telltale X-ray pulses that signal solar flares. But only a few satellites—including the Solar and Heliospheric Observatory (SOHO) and the two Solar Terrestrial Relations Observatory (STEREO) spacecraft—can detect whether a radiation storm or CME is actually headed toward the planet. The Advanced Composition Explorer (ACE) can measure the intensity and magnetic orientation of any CME that sweeps by it. But 20 to 50 minutes later, forecasters can merely watch the storm unfold on Earth.

Disturbingly, both SOHO and ACE are well past their nominal lifetimes, with no certain replacements. "Once SOHO ceases functioning, probably in the next year or so, we won't have its unique 'looking down the barrel of a gun' perspective on the sun for forecasting Earth-directed CMEs," says

Sten Odenwald, an astrophysicist affiliated with NASA's Goddard Space Flight Center. ACE has sufficient propellant to continue operations until roughly 2024, but there are no guarantees its instruments will last that long. Without ACE, Odenwald says, "we'll [still] be able to see a CME coming toward us, but we won't know whether its interaction with Earth's magnetic field will cause major fireworks or be relatively harmless."

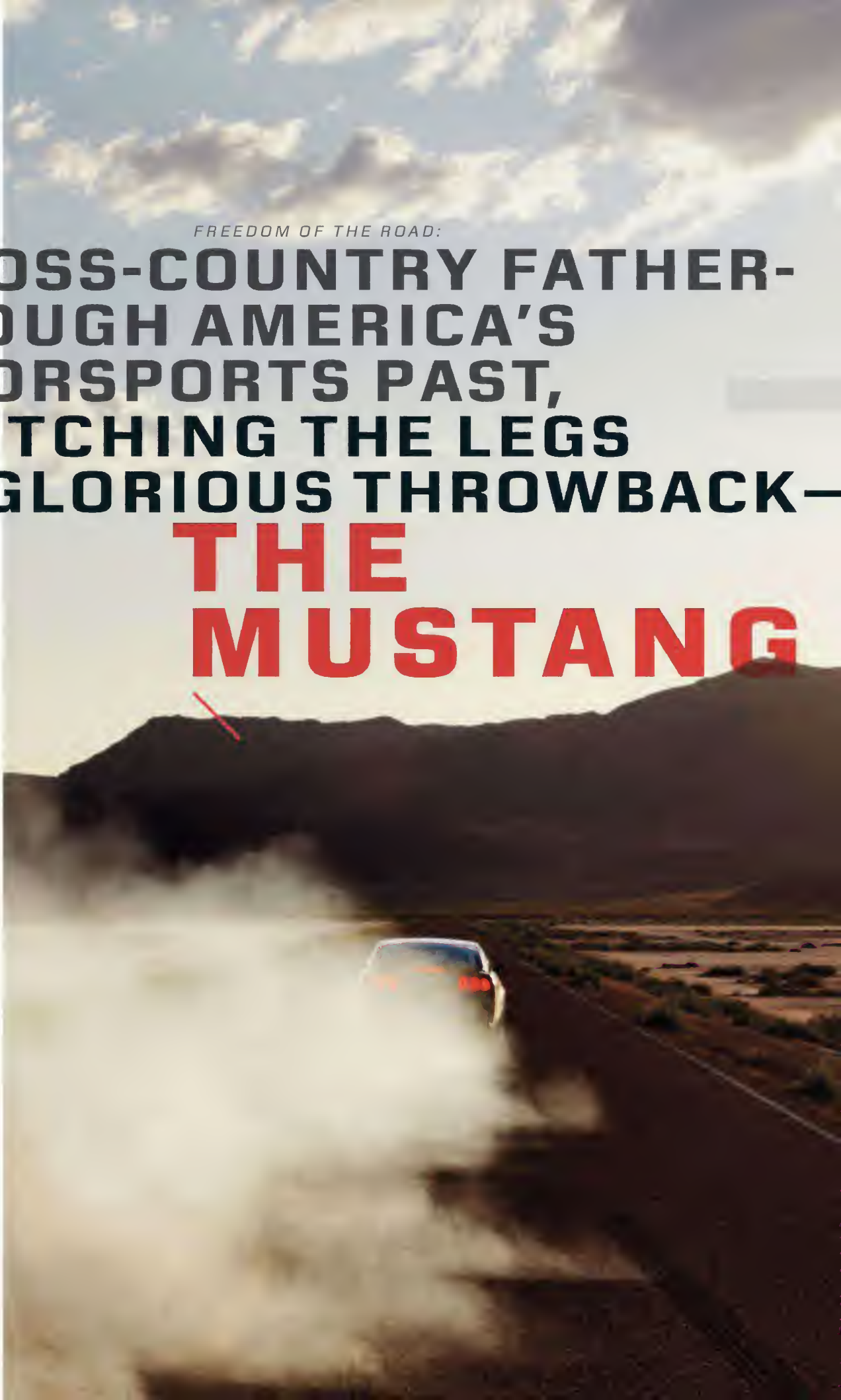
STEREO and another satellite, the Solar Dynamics Observatory, may be able to compensate for SOHO's eventual loss, but Lubchenco and other experts unanimously believe that allowing ACE's unique observational capabilities to expire would constitute a blind spot too large and risky to ignore. "Another great geomagnetic storm probably won't happen tomorrow, but that doesn't mean we shouldn't worry," Bogdan says. "The good news is, we've got time to prepare for this, but the bad news is, if we don't hedge our bets and buy down some risk, one day we're gonna get clobbered."

In fact, a spacecraft that could replace ACE currently sits in storage at Goddard's facility in Greenbelt, Md. The Deep Space Climate Observatory, or DSCOVR, is fully assembled and all but ready for launch—NASA simply lacked the funding to launch it into space seven years ago. As part of the Obama administration's budget request for 2012, NOAA would receive \$47.3 million to refurbish and launch DSCOVR to act as ACE's replacement, but the initiative died in the House.

After Foale rode a Soyuz TMA-3 capsule back to Earth in April 2004, he had blood drawn for an experiment that monitored his chromosomes. "Roughly, the rate of damage to my white blood cells went up by a factor of 10," he says. It dropped back down within the year. "Life has been dealing with radiation since it began," Foale says. "Repair mechanisms in the cells are very sophisticated." Human society, on the other hand, has evolved to be more fragile—complex, yet defenseless against a storm of solar radiation. Meanwhile, the sun continues to seethe. **PopMech**

FREEDOM OF THE ROAD:

**A CROSS-COUNTRY FATHER-
THROUGH AMERICA'S
MOTORSPORTS PAST,
STRETCHING THE LEGS
OF A GLORIOUS THROWBACK—
THE
MUSTANG**



AND-SON JOURNEY

LIKE A LOT OF KIDS, I GREW UP AROUND OLD IRON. ALFA ROMEDS, MGs, THE ODD

BY SAM SMITH

PHOTOGRAPHS BY THOMAS PRIOR

BOSS 302

Triumph—my father, Dan, an amateur racer, owned and drove more of them than I can count. But so did a lot of fathers.

My dad was different. When I was a boy, he set aside a midlevel marketing job of regular moves and little passion to follow his bliss: He wanted to start his own business. The first, an automotive bookstore, lasted only a few years. The second, a restoration shop that specialized in cantankerous European sports cars, existed in one form or another until I hit college.

That shop meant a lot to me. After school, I'd hang around my father's toolbox, watching him spin wrenches and solve problems. He had been teaching me to work on cars for years, but the shop was a stark cementing of principles. It made everything real.

I didn't think much of this—and didn't realize how important it was to me—until one night in the fall of 1998, when I was 17. Dad and I drove 10 hours from our home in Kentucky to Watkins Glen, N.Y.,

During a cross-country run in a Ford Mustang Boss that left little rubber on the tires, two petrolheads—the author and his father—gun the Boss's 444-hp V-8 and kick up a little Utah dust en route to the West Coast.

for the 50th anniversary of the first postwar American sports car race, held on the town's closed-off streets. Amateur drivers had flown around the town's houses at full tilt, with only hay bales and bunting separating them from packed spectators. It was the beginning of the country's modern speed era, a moment as significant as the inaugural Indianapolis 500 back in 1911. The area went on to host everything from IndyCars to Formula One—from Andretti to Zanardi.

The Glen's public road races are gone, victims of safety concerns, but the heart of that culture lives on at an Adirondack-style resort called Seneca Lodge, which sits on a hill overlooking town. The lodge hasn't changed much since 1948, and most people hope it never will, because it houses the most famous racing bar in America.

My father took me there on our first night at the lodge back in '98. A gentle and relatively quiet man, he didn't give me much warning that we were about to enter hallowed ground, a temple that has welcomed drivers since Truman was president. Instead, he just paused at the door and said, "This place is important."

The Seneca Lodge bar turned out to be no larger than a two-car garage, unprepossessing and poorly lit. Tattered photographs of dead drivers were pinned above the bar. Browned victory wreaths hung from darkly varnished walls.

But the place was filled with legends—heroes I had read about since I was a little boy. Formula One drivers and team managers sat in the corners, including 16-time Grand Prix winner Stirling Moss of Britain. American John Fitch, who won at Sebring and raced six times at Le Mans, was at a table with other winners who had too many checkered flags to their credit to count. There was pioneering American sports car driver and journalist Denise McCluggage. They were all in town for the anniversary, a living rogues' gallery from the stories of my youth. Dad and I stood there for a moment, soaking it all in, before he moved on



*I pulled into a Walmart.
"I forgot," I said. "I need to
buy a cheap wrench."
"What for?" Dad asked.
"For America," I said.*

to greet a few friends.

In that moment, I knew... well, I wasn't sure what I knew. But something clicked. A part of my life began to make sense.

In the years since, Dad and I have raced together and fixed cars together, and last summer we again walked through the door of the Seneca Lodge bar. The night wasn't as celebratory for the patrons there, but we were both thrilled, and not just to be back. We were about to fulfill a dream—a cross-country journey together to trace the history of American road racing, something we had wanted to do for years. Naturally, we started at the Glen. And for reasons both patriotic and reverent, we decided to make the trip in a 2012 Ford Mustang Boss 302.

The V-8-powered Boss is no ordinary Mustang. This is a rolling homage to the Boss 302s that con-

tested the Sports Car Club of America's Trans-American (aka Trans-Am) racing championship from 1969 to 1970. It's a snarly collection of historical cues (C-shaped side stripes, rocker-mounted side-pipe exhausts) and legitimate performance cred (adjustable dampers, limited-slip differential, Brembo brakes, optional Recaro seats). In terms of emotional appeal and over-the-road talent, it might be the greatest ponycar ever built.

The idea was to drive the Boss from Watkins Glen to California's Mazda Raceway Laguna Seca in Monterey. Along the way, we'd stop at a vintage race at Wisconsin's Road America, test the Ford's talents at a track day, and just generally inhale a bunch of blacktop.

We spent most of the first night in the Seneca bar, which felt like a return to baptismal waters for me. The next morning, Dad pulled a





At Wisconsin's Road America, the newly minted Mustang unites with racing versions of the original late-1960s model. Opposite: The author and his dad at the Seneca Lodge bar in Watkins Glen, N.Y.

dog-eared copy of Dave Friedman's *Trans-Am: The Pony Car Wars 1966-1972* from his luggage. The book is packed with hero drivers and pictures of Mustangs being shot-gunned around places like Laguna, which hosted the final race of Ford's championship-winning 1970 Trans-Am season. This is where I learned that my father, a life-long European-sports-car nut, has always had a soft spot for big V-8s. While loading the car, I walked out into the parking lot and found him staring at the Boss, arms crossed, giggling. My dad doesn't giggle. Memo to Ford: Whatever you're doing here, keep it up.

We gunned out of the Seneca at 9 am, sun glinting off the Boss's long nose. Fifteen minutes later, remembering a recent conversation with a Ford engineer, I pulled into a Walmart. "I forgot," I said. "I need to buy a cheap wrench."

3

LEGENDARY AMERICAN TRACKS



WATKINS GLEN INTERNATIONAL WATKINS GLEN, N.Y.

A fast, sweeping 2.4-mile circuit that overlooks Seneca Lake. Designed by a cadre of Cornell engineering professors to replicate the original street course.

SIGNATURE TURN: THE CLIMBING ESSES

Taken at full throttle, these switchbacks are critical to get right since they lead onto the long back straight where most of the passing occurs.



ROAD AMERICA PLYMOUTH, WIS.

Rewards flat-out courage because many turns require only minimal braking. Even low-powered Miatas average 80 mph around the 4 miles.

SIGNATURE TURN: THE KINK

A gentle right-hander negotiated at over 100 mph. Run wide and you'll smack a very nearby concrete barrier. Only the brave—or foolish—keep the throttle floored. Makes even pro drivers nervous.



MAZDA RACEWAY LAGUNA SECA MONTEREY, CALIF.

Snakes around and over a peak that's only a few miles from the Pacific. Intimidating and thrilling, with dramatic elevation changes and a rhythm that would be genius if it weren't accidental.

SIGNATURE TURN: THE CORKSCREW

A left-right combination that steeply plunges downhill. Drivers can't see the entire track surface, so they rely on memory to stay online.

"What for?" Dad asked.

"For America," I said.

Crawling underneath the Mustang in the parking lot—we used a parking curb as a jacking ramp—I loosened the exhaust brackets and pulled the factory-installed noise-abatement plates out of the side pipes, transforming the Boss's 5.0-liter V-8 from a subtle rumbler to a rolling peace disturbance. "This is great," I said, blasting up an on-ramp. "You think we'll get tired of it?"

"I can't hear you!" Dad yelled. "Can we make it louder?"

It soon became apparent that the Boss, like most Mustangs, is happiest just above the speed limit. The car eased into a long-legged lope that implied California was just over the horizon. Pennsylvania and Ohio flew by, the newly opened side pipes crackling every time we stopped for fuel.

What is it about loud cars that reminds you of aircraft in wartime? Eighty-five mph in sixth gear produced a steady, comforting, dawn-patrol drone. Full-throttle gear drops made my skin tingle and prompted furtive glances toward the horizon. (Fighters! Twelve o'clock!) At one point, with the Mustang exploding through the top of third gear, I heard Dad mutter, "Combat emergency power." When I looked over, he was squinting into the distance like Chuck Yeager.

With I-80 being both long and boring, we had a lot of time to talk. Dad told me stories of his Kentucky youth—how he crashed his MG Midget twice in high school, the big Detroit sleds his father drove, the moment he first felt drawn to muscle cars. At one point he paused and said, "I've always wanted a Mustang, but until now, it's never felt right. This car has been seeping into my head for 40 years."

We passed a school bus near Cleveland. When half the kids lowered their windows to watch, I stabbed the throttle, prompting cheers. Mustangs have been seeping into America's head for a while.

We reached the tiny village of Elkhart Lake, Wis., at the end of

the second day and headed for nearby Road America, a 4-mile-long, European-style track built in the 1950s. When my head hit the pillow that night, the Ford's pipes still rumbled in my ears.

The Boss's 302-cube overhead-cam V-8 is an evolution of the 412-hp Coyote engine found in the Mustang GT. It produces 444 hp and revs to an astonishing 7500 rpm. The gains over a GT are courtesy of CNC-machined cylinder heads, a long-runner intake manifold, larger intake valves, higher-lift cams, and a host of other tweaks. Maximum torque (380 lb-ft) comes at a relatively high 4500 rpm, so the engine feels somewhat peaky. A baffled oil pan helps maintain oil pressure during cornering. The end result is a corker. The 302's idle is smoother than poured cream, but the engine revs like it has a flywheel made of dryer lint. It reminds you of the weapons-grade V-8 fitted to the 1969-70 Boss 302s. And that's why we went to Wisconsin.

A few weeks before, I learned that the Historic Trans-Am Group—vintage racers who regularly exercise 1960s Trans-Am cars—was going to be at Road America during

With one wrench it's easy to yank the 302's factory noise cancelers.

our trip. A detour suddenly became mandatory. Watkins Glen hosted Trans-Am races for years, but Road America's long, tree-lined straights, steep hills, and wincingly fast corners always felt more suited to it.

In the Trans-Am's golden era—1966 to 1972—the series featured production-based, factory-backed cars; star drivers; and competition so close that drivers often banged door handles. It's been called the most crowd-pleasing racing in American history, and as the vintage cars—some worth seven figures—were started for the coming race, it was easy to see why. As each lit off, the noise mutated from an offbeat thunderclap—*BOOMa-whompa-BOOMa-whompa*—to a stunning cacophony. The drama was intoxicating.

We walked over to Turn Six, a third-gear left-hander, for the start. On the first lap the cars exploded into sight with a gut-punching din. Dad laughed involuntarily. The field slithered and pulsed through the corner, two and three deep, each car jockeying for position in a series of feints and dodges.

The field spread out as the race went on until the sound seemingly came from everywhere. Several original Boss 302s—including the championship-winning yellow 1970 car driven by Parnelli Jones





**A perfectly tuned engine deserves
a perfectly tuned motor oil.**

©2012 ExxonMobil Corporation. Mobil, Mobil 1 and the 1 icon are registered trademarks of ExxonMobil Corporation or one of its subsidiaries. NASCAR® is a registered trademark of The National Association for Stock Car Auto Racing, Inc.



Tuned for performance. Tuned for extremes. Tuned to keep your engine running like new. That's a perfectly tuned motor oil. That's Mobil 1 Extended Performance. Proven to protect your engine for up to 15,000 miles between oil changes. Mobil 1 Extended Performance. Get the full story at mobil1.us.



Run Like New. **Mobil 1**™

PopularMechanics

WANTS YOU!

Give Us a Piece of Your Mind and Enter to
WIN \$5000

The editors of Popular Mechanics would love to hear your opinion of the issue you're reading right now. Your responses—positive, negative, lukewarm—will help us shape future issues of the magazine. Take a quick survey and you'll be eligible to win \$5000.

Visit julysurvey.popularmechanics.com
to get started.



No purchase necessary to enter or win. Reader Feedback Sweepstakes. Sponsored by Hearst Communications, Inc. Beginning January 1, 2012 at 12:01 AM (ET) through December 31, 2012 at 11:59 PM (ET) go to www.julysurvey.popularmechanics.com and complete and submit the entry form pursuant to the on-screen instructions. One (1) Grand Prize winner will receive \$5,000, one (1) Second Place winner will receive a \$500 American Express gift card, and ten (10) runner-up winners will receive a \$100 American Express gift card. Odds of winning depend on the number of eligible entries received. Must be a legal resident of the 50 United States and D.C., Puerto Rico, or Canada who has reached the age of majority in his or her state, territory, or province of residence at time of entry. Void in the Province of Quebec and where prohibited by law. Sweepstakes subject to complete official rules available at www.julysurvey.popularmechanics.com.

and George Follmer—worked their way to the front of the pack. When the checker fell, I had no idea who won, and I didn't really care. I just wanted more.

Earlier that day we had met former Shelby Cobra racer Phil Gallant, who owns the first Boss 302 Trans-Am racer, a blue 1969 model that was built by Michigan's legendary Kar Kraft shop, prepared by Carroll Shelby, and driven by American ace Dan Gurney. "These cars are heavy, so they react slower than a Cobra," Gallant said. "They are a lot more dramatic—you drive sideways."

Walking back through the paddock, I ran into Jim Farley, Ford's vice president of global marketing, who was there to race his Cobra. Farley, who helped usher the 2012 Boss to production, once said it deserved to be on YouTube "doing something illegal." He told us about the car's development and mentioned that he had just been doing laps in his own Boss at GingerMan Raceway in South Haven, Mich., to see what it could do. GingerMan is roughly 2 hours northeast of Chicago. Twenty-four hours later we were rolling into the track's parking lot.

Caning the Ford around GingerMan's 2.14 miles was a revelation—the Boss has to be one of the most balanced street cars on the planet. Feed this car late apexes and gobs of throttle, and a blindfolded donkey could set lap records.

Dad did a few sideways laps and giggled again. When we grabbed a motel room that evening, he spent most of the night reading Brock Yates's *Sunday Driver*, a firsthand account of a novice's first season in the Trans-Am. I stared at the "Build Your Own" Mustang section of Ford's website, smitten.

The rest of the Midwest passed in a haze of midsummer heat. By the time we hit Nebraska, I had called in a few favors and found a Ford dealer who might sell me a Boss at sticker price. By Utah, I

knew the color I wanted (Competition Orange) and which options (Recaros, Torsen limited slip).

Talking about the Boss even got my father and me out of a few arguments—our relationship has never been perfect, but the Mustang smoothed out the bumps. The car, like Seneca Lodge, meant something to us that we couldn't nail down, something that obviously chimed with a lot of other people too. (I've never been on a trip where so many men asked what I was driving.)

A day later we rolled into Laguna Seca, thoroughly exhausted. A MotoGP race—Formula One for motorcycles—was carving up the track, so we left the dusty Ford in a parking lot and bought tickets. Laguna looks just as it did in Friedman's book, albeit with modern, clinical catch fencing and lots of runoff area. Compared with the raw streets of the Glen, it was a cold testament to progress. But mostly, it made me hanker for more sideways Trans-Am cars. Or a Boss of my own.

About that: Two days earlier, at a truck stop in Grand Island, Neb., I stumbled onto a bin of Hot Wheels cars. Dad dug in and pulled out a Mustang. It was a 1970 Boss race car, complete with Parnelli Jones's name on the roof. I bought it and rolled out of Grand Island feeling like I'd just won the lottery.

After returning the 2012 Boss to Ford, I flew home to Chicago and discussed the Mustang with my wife. She informed me that we couldn't sell the couch and the refrigerator and most of my clothing to buy one. But a month later, Dad texted me a picture of a Kona Blue 2012 Boss 302 on temporary tags parked in his driveway. He had found one at his hometown Ford dealer one afternoon and bought it. Just like that.

I walked into my garage, moved my wife's car out, and set the Hot Wheels Boss on the ground in its place. I stared at it for a few minutes, and then walked back into the house. **PopMech**



HOW TO PREP AND MOD YOUR CAR FOR THE **TRACK**

It's never been easier to test your car—and yourself—on a racetrack. Several circuits offer "test and tune" lapping sessions where a small entry fee gives you access to a speed-limit-free asphalt ribbon. The Sports Car Club of America and the National Auto Sport Association regularly host track days for novices. Of course, your steed will need some attention. Get addicted—trust us, it isn't hard—and you'll find yourself modifying your car for greater control and speed. Car racing, however, is filled with axioms like "How do you make a small fortune in racing?" The answer: Start with a large one. You've been warned.

BY LARRY WEBSTER



The author [right], his dad—and the Boss—in the American west.

> THE BASICS

> INCREASING PERFORMANCE

> DEDICATED TRACK MACHINE

1



2



3



ENGINE

Make sure the motor is up to snuff by inspecting the coolant hoses (they should be flexible). Change the oil and top up all the fluids.

A computer reflash can unleash more power from turbo engines but voids the warranty. For the rest, consider freer-flowing air filters and exhausts.

Aftermarket supercharger and turbocharger kits are the bang-for-your-buck kings. Beware: Extra spice stresses the drivetrain.

SUSPENSION

Inspect for leaking shocks or torn axle boots. Weaknesses here will show up at the worst possible time.

Stiffer antiroll bars can increase handling precision. Adjustable bars are even better; they let you dial out understeer.

Lower the car with shorter springs. Preexisting suspension kits are usually preferred because the manufacturer has (we hope) figured out hard-to-determine details—like spring rates.

BRAKES

For your first track visit, just make sure everything is in good working order. For the second, change the fluid to higher temp stuff like AP600.

Track driving fries brakes. Switch the pads to ones with higher temperature capability, such as the Hawk HP Plus. These pads consistently slow the car, even after repeated laps.

Faster cars require larger—both in thickness and diameter—brake rotors to dissipate heat. You might also need larger wheels to fit the new binders.

TIRES

Tire flex is an issue, so add 5 to 10 psi (cold) and keep an eye on tread wear.

Swap all-season tires for performance meats. Look for tread-wear ratings of around 140 to get a good mix of street durability and racetrack grip.

"Slick" tires have no tread and are like driving on marbles when it rains. But, designed for racing, they put more rubber on the road—increasing cornering speeds and shortening braking zones.

PROTECTION/RECOVERY

A helmet is a must. Buy one with a Snell 2005 rating or better since it's accepted by most organizers. And don't forget eye protection.

Eventually, you'll make a mistake, slide off the pavement, and become beached in a gravel trap. Install factory tow hooks before you hit the track to ease recovery.

Now you're hard on the gas—everywhere. Increase safety with a steel interior cage. Bolt-in units are available for around \$500, but custom-welded cages typically allow easier access.

THE RIGHT STUFF

Piloti Prototipo shoes (\$85) have curved heels that make operating the pedals easier.

By now, you've got racetrack fever. Car modifications won't increase speed nearly as effectively as better driving. Skip Barber high-performance driving courses (\$1300 and up) are run throughout the country.

Measuring the temperature across the tire's tread tells you if the setup is correct (generally, you want equal temps across the tread). Intercomp's digital pyrometer (\$189) does the job.



ESCORT
DRIVE SMARTER™



Enjoy your drive with ultimate ticket protection

"The 9500ix is the
best GPS-enabled radar
detector on the planet."
—RadarTest.com

"You might as well
have the best...
the PASSPORT 9500ix"
—Popular Mechanics



"The PASSPORT 9500ix
proved to be the best
radar detector"
—1stRadarDetectors.com

PASSPORT 9500ix. Get the best protection available. \$499.95



These days, the police have more ways than ever to monitor your speed—from radar to laser to speed cameras. Protect yourself with the ESCORT PASSPORT 9500ix, the detector that is revolutionizing the industry. It's GPS enabled, so it can detect and alert you to all radar, laser and safety cameras.

The 9500ix is the most intelligent detector available. Now get expanded ticket protection with ESCORT Live!®, the ultimate live alert network. ESCORT detectors equipped with patented ESCORT Live! technology have won four top industry awards for 2012: CES Innovations Award; SEMA Best New Mobile Electronics Product; Popular Mechanics Editor's Choice Award; and Car and Driver's 10 Best Technology Advances. The experts agree that no other detector beats the PASSPORT 9500ix.



Don't just drive. . . Drive Smarter with ESCORT

800.852.6258 EscortInc.com Facebook.com/DriveSmarter
Department PMECH ©2012 ESCORT Inc. *Requires additional equipment and subscription.

AMERICA NEEDS AN OIL CHANGE

RACE TRACK TESTED

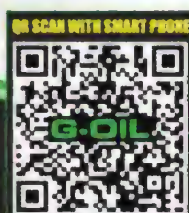
BACKYARD PROVEN

Lumberjack Woodchopper,
& Hot Saw World Champion
Mike Sullivan

The world's first & only API certified
USDA BioPreferred® Ultimate
Biodegradable Full Synthetic
OIL from OUR soil.



GROWN & MADE IN THE USA



REDUCE DEPENDENCE
ON FOREIGN OIL

Available at
Walmart
Save money. Live better.

G.E.T. a rebate coupon from www.getg.com/popularmechanics
GREEN EARTH TECHNOLOGIES
877.E22BGRN (877.392.2476) | www.GETG.com

*Ultimate Biodegradable is the highest biodegradability ranking determined by ASTM Standards (2.1 ASTM D-5864)

CURES & PREVENTS ETHANOL FUEL PROBLEMS

Star brite
STARTRON®



- ★ Makes engines start easily, run smoothly
- ★ Removes & prevents gum, varnish and carbon
- ★ Works in all engines & all fuel
- ★ Helps prevent phase separation by dispersing water throughout fuel as submicron-sized droplets that are safely eliminated while the engine operates
- ★ Stabilizes fuel; rejuvenates old fuel
- ★ New 1 fl. oz. Shooter treats 6 gallons of fuel



SCAN FOR INFO



FIND
US ON



**IT'S NOT THE ENGINE,
IT'S THE FUEL!**

WWW.STARTRON.COM

BETTER MPG!

p. 124

TECH

Your home movies should be more than just trips down memory lane. Use these five video-editing strategies to turn your rough footage into a captivating story anyone can enjoy. **p. 134**

W

weekend

The guide to your DIY life



HOME



SCIENCE



AUTO

ADVENTURE TECH

A BRIEF HISTORY OF...

Fireworks. Now *this* is an explosive story—colorful, too. **p. 148**

ADVENTURE

People think: Sure, I can paddle a canoe. But it's not that simple. Here's the right way to row. **p. 131**

EARLY ADOPTER

The Donaldson brothers show why building a boombox from scratch is child's play. **p. 138**

AUTO

Don't Be an Idiot

Why opening the radiator cap of your car's hot engine isn't such a hot idea. **p. 127**

Q+A

Our experts tackle your toughest tech, home, and auto questions.

TESTED & RATED!

How much riding mower can you get for under \$2000? **p. 110**

HOME

Do you really need all that neatly clipped turf in your yard?

If the answer is yes, that's okay. But we've got options for a more relaxed and less labor-intensive landscape. **p. 104**

AUTO

Air tools—the staple of any serious car guy's garage—make tough jobs easy and impossible ones feasible. We show you how to get started with pneumatic power.

p. 120

EXPERT TECH ADVICE



VIDEO-EDITING TIPS FROM AN INDUSTRY VETERAN. **p. 135**

SCIENCE

The great firefly count is on! Do your part. It's fun and scientifically beneficial. **p. 118**



diy

Home

-YARD
ECONOMICS
-TESTING
LAWN
TRACTORS
-GARDEN
TOOL REPAIR



BY ROY
BERENDSOHN

SCALING BACK

IS AN EXPANSIVE LAWN RIGHT FOR YOU? HERE'S HOW TO PICK A LANDSCAPE PLAN THAT SUITS YOUR STYLE AND BUDGET.

W

Whether compelled by tradition, keeping up with the Joneses, or the joy of spending time outdoors, 69 percent of U.S. homeowners do their own yardwork, and maintain 40,000 square miles of lawn. Mowing, blowing, raking, weeding . . . the list of tasks is long—but it doesn't have to be. To illustrate the point, Julie Bargmann, a New

York-based landscape architect, sketched three versions of a typical $\frac{1}{4}$ -acre residential lot for *POPULAR MECHANICS*, from high- to low-maintenance. (Full disclosure: She's my sister.) "A lot of chemicals and water are used to get 'perfect' yards," Bargmann says. "But there are alternatives. It can be liberating to apply a less labor-intensive aesthetic to your personal outdoor space."

Other landscape experts we consulted share this sentiment. They say that reducing yardwork involves shrinking lawn size, increasing your plant palette, and using less water and chemicals. "A sustainable landscape can mean spending fewer hours on the yard," according to Judy Nauseef, a landscape designer from Iowa City, Iowa.

Here's a look at a few options. — JOE BARGMANN



Who It's For Fastidious people with green thumbs, time to burn, a yen for outdoor entertaining, and what Jeff Trojanowski, a Los Angeles landscape architect, describes as a "formal, colonial" aesthetic.

Pros Neighborhood bragging rights; privacy created by perimeter plantings and fence; a soothing sense that all is in order; plenty of space for lawn games when hosting the big July Fourth family barbecue.

Cons Hassle of weekly yard-waste disposal (especially onerous after hedge trimming); high water bills; painful puncture wounds from rose-garden maintenance; obligation to host the big July Fourth family barbecue.

Tools Gas mower, hedge trimmer, string trimmer, blower, pruners, lots of hoses, sprinklers, pump sprayer, fertilizer spreader.





WEEKEND

10

MEDIUM

17
hours a week\$2075
annual upkeep

LOW

8
hours a week\$2545*
annual upkeep

Who It's For Families with soccer mom/dad duties (thus, less time for yardwork) who like to be "green" and also want to get good use out of their outdoor space; couples who enjoy gardening but refuse to be slaves to it.

Pros Clippings pile/compost area for on-site yard-waste disposal; just enough lawn for fun but not too much to mow; softer edges and semiwild feel show that you care about appearances—but not to a fault.



Cons While you'll be mowing less, you'll have to bone up on your other gardening skills, such as pruning, to maintain the flowering shrubs, perennials, and shrub borders. Resist the urge to call in a pro. C'mon, you can do it yourself!

Tools Cordless electric mower, string trimmer, and hedge trimmer; loppers, pruning shears, leaf rake, garden cart.



Who It's For Birkenstock-wearing college professors or nonprofit employees who practice sustainable living and are oblivious to their eccentricities—or embrace them and couldn't care less what the neighbors think.

Pros No lawn to mow! Deciduous trees provide shade in summer and allow sun in winter; vegetable garden promotes healthy eating. Mulch paths feel good under Birkenstock-clad feet.

Cons Vegetable garden is labor-intensive; fall cleanup includes tedious removal of leaves from ground cover; forest-like yard attracts critters (animals and insects).



Tools Electric blower and string trimmer, small mulcher, hand tools for gardening, loppers, pruning shears, rake, wheelbarrow.

*Includes high initial cost to establish ground cover.



Casting Call

MAKE A ROCK-SOLID PLANTER OUT OF TINTED CONCRETE. BY JOSEPH TRUINI

Concrete is just as useful and versatile today as it was when the Romans discovered how to make it 2000 years ago. Early masons used the humble mix of cement, sand, stone, and water to build impressive structures such as the Pantheon (A.D. 126), which is still in use as a house of worship. With its stout granite columns and massive concrete dome, the Pantheon gives new meaning to "built to last."

Today, we use concrete for everything from home foundations to kitchen counters. It's also a great material for making smaller items, such as the planter shown here. Super-sturdy but simple to build, it requires the construction of inner and outer wood forms to mold the finished product. Basic carpentry tools, a wheelbarrow, and an 80-pound bag of concrete mix are all you need to do a job that would make a Roman proud.

W

WEEKEND



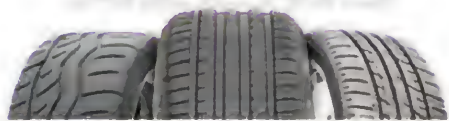
"It's very satisfying to mix up a batch of concrete, pour it out, and then eagerly wait for it to harden into something brand-new." — J.T.

GLOSSARY

OCULUS

In architecture, the Latin word for "eye" describes circular windows, skylights, and other openings, such as the hole in the top of the dome of the Pantheon in Rome. Specific to 17th-century Baroque architecture, *oculus* and *oeil-de-boeuf* [French for "bull's-eye"] are used interchangeably.

BRED FROM RACING DNA



RT615K

FK453

PT722



SCAN FOR YOUR CHANCE TO
WIN THIS PORSCHE 911 CARRERA SPORTS CAR

FALKEN
TIRE

WE GET YOU GOING®



Visit us at falkentire.com

NO PURCHASE NECESSARY. A PURCHASE WILL NOT INCREASE YOUR CHANCES OF WINNING. Must be legal resident of the 50 United States (D.C.) 18 years or older as of the start date. Sweepstakes ends 10/21/12. For entry and official rules with complete eligibility, prize descriptions, odds disclosure and other details, visit www.falkentire.com/porsche911. Sponsored by Falken Tire, Corp. Void where prohibited. PORSCHE®, the PORSCHE CREST®, CARRERA® 911® and the distinctive shape of the PORSCHE® 911® sports car are registered trademarks of Dr. Ing. h.c. F. Porsche AG. Porsche Cars North America, Inc. and Dr. Ing. h.c. F. Porsche AG are not affiliated or associated with this sweepstakes in any way.



1 Form and Cast

Screw together the inner and outer forms. Coat the exterior of the inner form with glue, and cover the surface with aluminum foil. Do the same for the inside face of the outer form. Spray cooking oil on the foil surfaces.

Place the inner form, top-down, on the mounting board. Screw through the bottom of the board into the form's cross supports. Place the outer form over the inner one, and use angle brackets to secure the outer form to the mounting board.

Empty an 80-pound bag of Quikrete Countertop Mix into a wheelbarrow. Add about 5 ounces of buff liquid cement color to 1 gallon of water in a bucket. Add the tinted water to the powdered concrete a couple of cups at a time until the mixture is malleable but not runny.

Pour the concrete into the form (left, top). Repeatedly plunge a scrap-wood stick into the concrete to consolidate it. Overfill the form, then run an oscillating sander (without sandpaper) over the entire form to vibrate out voids. Strike off excess concrete. Form drain holes by pushing two dowels coated with petroleum jelly through the concrete.

Strip the Outer Form

After letting the concrete set for 18 hours, unscrew and disassemble the outer form (left, center). Grab and twist out the dowels with pliers.



3 Pull the Inner Form

Remove the screws driven through the bottom of the mounting board and into the inner form. Tip the planter over and pull out the inner form (left, bottom). After the concrete has cured for 24 hours, apply a liberal coat of clear masonry sealer to the entire planter. Once the sealer cures, you're ready to plant!



THE RECYCLER

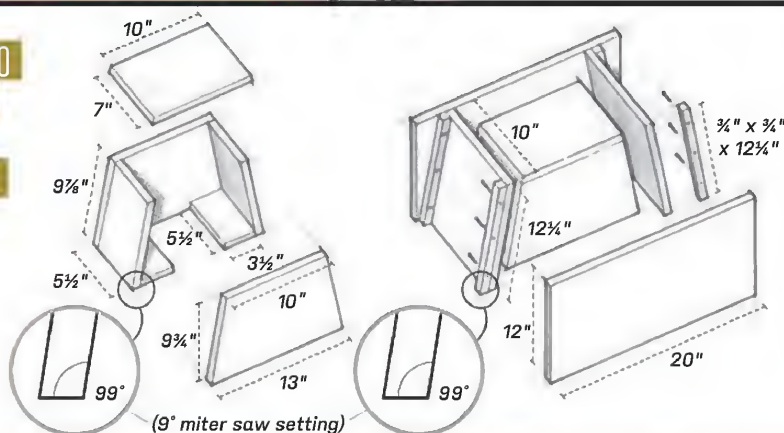
PATIO-UMBRELLA STAND

POPULAR MECHANICS READER **TED ABT** OF MORRISVILLE, PA., FOUND A GOOD USE FOR PVC PIPE AND A 5-GALLON PLASTIC BUCKET LEFT OVER FROM A REMODELING JOB.

How to Make It

Dump most of an 80-pound bag of concrete into the bucket, add water, and mix. Use duct tape to seal one end of a piece of 1½-inch PVC pipe, and push that end into the slurry. After the concrete sets, bore ¼-inch drain holes through the bucket. Top the concrete with a layer of gravel covered with potting soil. Plant flowers, and insert a patio umbrella. Enjoy!

HOW TO BUILD THE FORMS



W

WEEKEND

ILLUSTRATIONS BY GEORGE RETSECK (PLANTER PLANS), BARQVIDEO (UMBRELLA STAND)

DISCOUNT TIRE DIRECT

discounttiredirect.com

888.916.3211

M-F 8am-9pm EST SAT 9am-6pm EST

Se habla español



"Just ordered my 3rd set of tires from Discount Tire Direct. All I can say is your customer service is the best. Thank you!"

— Colm McIvor via Facebook

FALKEN
Wild Peak A/T tires
ORC 909 wheels



FREE SAME DAY SHIPPING

Same day shipping available for most orders. Valid for UPS Ground services to the 48 contiguous states. Some restrictions apply.

Now accepting **PayPal**



SEVEN X

13" PRICES START AT

\$70

INCIDENT

13" PRICES START AT

\$75

DR-33

14" PRICES START AT

\$84



WARRIOR

15" PRICES START AT

\$95

CHAOS

15" PRICES START AT

\$106

STRIKE 5

16" PRICES START AT

\$125



ZIEX ZE-612

PRICES START AT

\$68

ASSURANCE FUEL MAX

PRICES START AT

\$91

VENTUS V12 EVO

PRICES START AT

\$99



GEOLANDER A/T-S

PRICES START AT

\$109

DYNAPRO ATM

PRICES START AT

\$119

ROCKY MOUNTAIN ATS

PRICES START AT

\$132



CURRENT PROMOTIONS

View our current specials online at
discounttiredirect.com

Fisher's ATV World
Official Partner
fishersatvworld.com



ONLINE TOOLS

CUSTOMER REVIEWS

Find out which tires
are best for you!



INTERACTIVE WHEEL SYSTEM

See wheels on
your vehicle!





Riding Mowers

TOOL TEST



A TOP-OF-THE-LINE RIDING MOWER RACES PAST THE \$5000 MARK. BUT FOR MOST HOMEOWNERS, A MORE MODEST INVESTMENT WILL CUT IT. WE TESTED FOUR HOME-CENTER TRACTORS AT A HORSE FARM IN UPSTATE NEW YORK TO FIND OUT HOW MUCH TRACTOR YOU GET FOR LESS THAN \$2000. BY ROY BERENDSOHN

◀ "America's love of tractors reaches back for generations and stands true today."

HUSQVARNA YTH21K46

RANKING ★★★★★

The Husqvarna is equally at home on wide-open lawns and in tight spots. A large lever by the steering wheel enables quick engagement and disengagement of the mower deck, and right-foot pedals allow for easy speed control and switching between forward and reverse. The pedals are especially helpful when your hands are full turning the steering wheel while mowing in close quarters.

Dislikes: The Husq lacks a dash-mounted mechanical fuel gauge.

PRICE: \$1600
ENGINE [HP]: 21
DECK [INCHES]: 46

RANKING ★★★★★

CUB CADET LTX 1045

PRICE: \$1900
ENGINE [HP]: 20
DECK [INCHES]: 46

If your lot is small or has complex landscaping, requiring a lot of back-and-forth mowing, the Cub is your machine. The hydrostatic-drive foot pedals to the driver's right are large, especially the reverse pedal. Similarly, its interlock for mowing in reverse is connected to the ignition switch, and its position is clearly marked and accompanied with a push-button. For those who have been baffled by other, less helpful reverse-mowing setups, this could be a real plus.

Dislikes: Nothing noted.



The Deere is sure-footed going up and down hills, over roots, and around any obstacle. This is due to the foot-pedal hydrostatic drive and a PTO (power takeoff) lever by the steering wheel that makes it easy to work around rocks and other obstructions. A large lever on the left-hand side helped us swiftly lift the deck out of harm's way. **Dislikes:** These are minor complaints, but the plastic hood hinge, seat, and discharge chute are insubstantial and evidence of cost cutting.

PRICE: \$1700
ENGINE [HP]: 21
DECK [INCHES]: 42

PRICE: \$1740
ENGINE [HP]: 21
DECK [INCHES]: 46

A large lever on the right rear fender shifts the tractor into forward or reverse. It's like cruise control, an ideal feature for mowing big areas. Fat rear tires—the 9-inch treads are 2 inches wider than those of the other three mowers—reduce tire marking.

Dislikes: We liked the Craftsman better on wide-open areas than on the intricate parts of our test course because we found ourselves constantly taking our hands off the steering wheel to shift into forward or reverse.

JOHN DEERE D110

RANKING ★★★★★

RANKING ★★★★★

CRAFTSMAN YT 3000

W

WEEKEND



DEAL WITH IT. IT'S WHAT MEN DO.

YOU FACE THINGS HEAD ON. WHY WOULD THIS BE ANY DIFFERENT?

More than half of all men over 40 have some degree of erectile dysfunction (ED).^{*} If you're one of them, ask your doctor about VIAGRA. It's America's most prescribed ED treatment.

For more information go to viagra.com or call 1-888-484-2472 (1-888-4VIAGRA).

THIS IS THE AGE OF TAKING ACTION.

VIAGRA[®]
(sildenafil citrate) tablets

WITH EVERY AGE COMES RESPONSIBILITY. IMPORTANT SAFETY INFORMATION BELOW.

We know that no medicine is for everyone. Don't take VIAGRA if you take nitrates, often prescribed for chest pain, as this may cause a sudden unsafe drop in blood pressure.

Talk with your doctor first. Make sure your heart is healthy enough to have sex. If you have chest pain, nausea, or other discomforts during sex, seek medical help right away.

In the rare event of an erection lasting more than four hours, seek immediate medical help to avoid long-term injury.

In rare instances, men who take PDE5 inhibitors (oral erectile dysfunction medicines, including VIAGRA) reported a sudden decrease or loss of vision, or sudden decrease or loss of hearing. It is not possible to determine whether these events are related directly to these medicines or to other factors. If you experience any of these symptoms, stop taking PDE5 inhibitors, including VIAGRA, and call a doctor right away.

The most common side effects of VIAGRA are headache, facial flushing, and upset stomach. Less common are bluish or blurred vision, or being sensitive to light. These may occur for a brief time.

VIAGRA does not protect against sexually transmitted diseases including HIV.

Please see Important Facts for VIAGRA on the following page or visit viagra.com for full prescribing information.

^{*}Data taken from the *Massachusetts Male Aging Study*. Of 1,290 respondents, 52% stated that they had some degree of ED.

You are encouraged to report negative side effects of prescription drugs to the FDA. Visit www.FDA.gov/medwatch or call 1-800-FDA-1088.

VGU00761 ©2010 Pfizer Inc.
All rights reserved.



IMPORTANT FACTS

VIAGRA®
(sildenafil citrate) tablets

(vi-AG-rah)

IMPORTANT SAFETY INFORMATION ABOUT VIAGRA

Never take VIAGRA if you take any medicines with nitrates. This includes nitroglycerin. Your blood pressure could drop quickly. It could fall to an unsafe or life-threatening level.

ABOUT ERECTILE DYSFUNCTION (ED)

Erectile dysfunction means a man cannot get or keep an erection. Health problems, injury, or side effects of drugs may cause ED. The cause may not be known.

ABOUT VIAGRA

VIAGRA is used to treat ED in men. When you want to have sex, VIAGRA can help you get and keep an erection when you are sexually excited. You cannot get an erection just by taking the pill. Only your doctor can prescribe VIAGRA.

VIAGRA does not cure ED.

VIAGRA does not protect you or your partner from STDs (sexually transmitted diseases) or HIV. You will need to use a condom.

VIAGRA is not a hormone or an aphrodisiac.

WHO IS VIAGRA FOR?

Who should take VIAGRA?

Men who have ED and whose heart is healthy enough for sex.

Who should NOT take VIAGRA?

- If you ever take medicines with nitrates:
 - Medicines that treat chest pain (angina), such as nitroglycerin or isosorbide mononitrate or dinitrate
- If you use some street drugs, such as “poppers” (amyl nitrate or nitrite)
- If you are allergic to anything in the VIAGRA tablet

BEFORE YOU START VIAGRA

Tell your doctor if you have or ever had:

- Heart attack, abnormal heartbeats, or stroke
- Heart problems, such as heart failure, chest pain, or aortic valve narrowing
- Low or high blood pressure
- Severe vision loss
- An eye condition called retinitis pigmentosa
- Kidney or liver problems
- Blood problems, such as sickle cell anemia or leukemia
- A deformed penis, Peyronie’s disease, or an erection that lasted more than 4 hours
- Stomach ulcers or any kind of bleeding problems

Tell your doctor about all your medicines. Include over-the-counter medicines, vitamins, and herbal products. Tell your doctor if you take or use:

- Medicines called alpha-blockers to treat high blood pressure or prostate problems. Your blood pressure could suddenly get too low. You could get dizzy or faint. Your doctor may start you on a lower dose of VIAGRA.
- Medicines called protease inhibitors for HIV. Your doctor may prescribe a 25 mg dose. Your doctor may limit VIAGRA to 25 mg in a 48-hour period.
- Other methods to cause erections. These include pills, injections, implants, or pumps.
- A medicine called REVATIO. VIAGRA should not be used with REVATIO as REVATIO contains sildenafil, the same medicine found in VIAGRA.

POSSIBLE SIDE EFFECTS OF VIAGRA

Side effects are mostly mild to moderate. They usually go away after a few hours. Some of these are more likely to happen with higher doses.

The most common side effects are:

- Headache
- Feeling flushed
- Upset stomach

Less common side effects are:

- Trouble telling blue and green apart or seeing a blue tinge on things
- Eyes being more sensitive to light
- Blurred vision

Rarely, a small number of men taking VIAGRA have reported these serious events:

- Having an erection that lasts more than 4 hours. If the erection is not treated right away, long-term loss of potency could occur.
- Sudden decrease or loss of sight in one or both eyes. We do not know if these events are caused by VIAGRA and medicines like it or caused by other factors. They may be caused by conditions like high blood pressure or diabetes. If you have sudden vision changes, stop using VIAGRA and all medicines like it. Call your doctor right away.
- Sudden decrease or loss of hearing. We do not know if these events are caused by VIAGRA and medicines like it or caused by other factors. If you have sudden hearing changes, stop using VIAGRA and all medicines like it. Call your doctor right away.
- Heart attack, stroke, irregular heartbeats, and death. We do not know whether these events are caused by VIAGRA or caused by other factors. Most of these happened in men who already had heart problems.

If you have any of these problems, stop VIAGRA. Call your doctor right away.

HOW TO TAKE VIAGRA

Do:

- Take VIAGRA only the way your doctor tells you. VIAGRA comes in 25 mg, 50 mg, and 100 mg tablets. Your doctor will tell you how much to take.
- If you are over 65 or have serious liver or kidney problems, your doctor may start you at the lowest dose (25 mg).
- Take VIAGRA about 1 hour before you want to have sex. VIAGRA starts to work in about 30 minutes when you are sexually excited. VIAGRA lasts up to 4 hours.

Don't:

- Do not take VIAGRA more than once a day.
- Do not take more VIAGRA than your doctor tells you. If you think you need more VIAGRA, talk with your doctor.
- Do not start or stop any other medicines before checking with your doctor.

NEED MORE INFORMATION?

- This is only a summary of important information. Ask your doctor or pharmacist for complete product information OR
- Go to www.viagra.com or call (888) 4-VIAGRA (484-2472).

Uninsured? Need help paying for Pfizer medicine? Pfizer has programs that can help. Call 1-866-706-2400 or visit www.PfizerHelpfulAnswers.com.



Distributed by:
Pfizer Labs
Division of Pfizer Inc. NY, NY 10017

Rx Only ©2010 Pfizer Inc All rights reserved. Printed in the USA.
VGIF Rev 5 01/10

Registered trademarks are the property of their respective owners.



SKYSCOUT®

Celestron's SkyScout® Personal Planetarium® locates and identifies over 50,000 stars, planets and constellations from its built-in celestial database. SkyScout also provides comprehensive text and audio descriptions including history, mythology and other entertaining information for the most popular celestial objects. Take it anywhere and learn about the Universe tonight!



Visit www.celestron.com for more information.

SAMSUNG HOME THEATER



With Samsung vacuum tube technology, great sound comes naturally. Bring audio to life with the Samsung Audio Dock system featuring vacuum tube technology and enjoy music the way it was meant to be heard as the natural warmth of the analog tubes deliver a truer, richer, more immersive sound. Experience the future of home audio.



Visit www.samsung.com/hometheater for more information.

EPOXY SHIELD

Rust-Oleum's EPOXY SHIELD Garage Floor Coating brings the latest technology to your garage. With a simple roll-on application you can create a stunning showroom finish. And its unsurpassed performance is 100% guaranteed. So go ahead and add a new room to your house this weekend.



Visit www.epoxyshield.com for more information.



IN THEATERS JUNE 29
GIJOMOVIE.COM



Home Clinic

BY ROY BERENDSOHN

PHOTOGRAPH BY SETH SMOOT

Handle With Care

I have some old farming tools that have been in my family for years, and I want to restore them. Most need wood handles that I can't find for sale anywhere. Please help.



Tip: For the strongest grain orientation, place the oval grain rings on the new handle so they are on the side, not the top or bottom.

It's tremendously satisfying to put a tool back in working order, especially one that connects you with your ancestors.

I've done the job many times, and I always start by contacting the House Handle Company (househandle.com). The 70-year-old family business in Cassville, Mo. (pop. 2185), makes handles of white oak, ash, and hickory for hammers, axes, wheelbarrows, picks, and hoes—as well as for some very obscure tools. I've worked with tools all of my adult life and have written about them for this magazine for 25 years, yet House makes handles for ones I've never heard of.

The first step in replacing a handle on an agricultural tool is pretty straightforward—you just knock off the head and the ferrule (the metal sleeve on the handle's end) with a hammer. If the head is secured by rivets, grind off their heads, and drive out the shanks using a pin punch and a ball-peen hammer. Alternatively, you can drill out a rivet: Place a center punch on the head, whack the punch with a hammer, and drill on the center mark. If the head doesn't come off and ride up the drill bit, shear off what remains with a sharp cold chisel.

Now you can connect the tool-head to the new handle. It's important to get the proper grain direction for handles on shovels, forks, hoes, and rakes (see the drawing at left). Next, drive the handle into the tang (the long metal tab) at the end of the head.

To rivet on a new handle, drill through the handle, guided by the old rivet holes. Insert the rivets, place the socket on a firm surface, such as a block of 4 x 4 lumber, and dome the rivet head with a ball-peen hammer.

Finally, clean off any rust on the toolhead using coarse sandpaper

W

WEEKEND

WHEN YOU PEAK YOU WIN.TM

Use PEAK® Motor Oil for PEAK Performance. Changing your oil helps improve engine performance and gas mileage. Save money on gas. Change your oil, change to PEAK.



CHANGE YOUR OIL, SAVE ON GAS.

Available at these and other fine retailers:



©2012 World Wide Motocycle, Inc. All Rights Reserved.



and a wire brush. Sharpen any dull cutting surfaces with a 10-inch Home and Garden file (coopertools.com). Shoot a thin film of spray lubricant onto the toolhead, and you're ready to go to work.

Clean Cut

When I'm painting, I never can seem to get a clean line in the corners. I've tried masking tape and bought trim brushes. No matter what I do, it never comes out neat. What's the trick?

You need one of two things to cut a clean line: a steady hand or masking tape. If you use the latter, buy high-quality blue or green crepe painter's tape. Tan masking tape is cheaper, but it's all but impossible to get a crisp line with the stuff.

Using a clean, damp cloth, wipe down the surface where you are going to apply the tape. This removes dust that would prevent the tape from bonding; if the tape doesn't bond, paint will get under it and you'll be left with a messy line when you remove the tape.

Apply the tape to the edge, but take care not to stretch it as you press it into place. Finish by burnishing the tape onto the surface using a metal or plastic putty knife.

Spread the paint and let it dry to the touch before stripping the tape. If you're really concerned about leaving a clean edge, carefully run a utility knife along the paint line to score it before removing the tape. Now gently pull the tape off the surface. If you hear a sharp ripping noise as the tape is coming off the wall, the ceiling, or the trim, you're moving too fast. Pull the tape firmly from the surface and angle it back at 45 degrees so it comes away in a shearing action.

The no-tape option is freehand-painting, or "cutting in," a clean line. Buying a high-quality trim brush is a good start—but be sure that it's the right brush. Most cutting in is done with one that's 2 or 2½ inches wide. A brush that's much wider or narrower is more difficult to control. Also, the brush should be appropriate for the paint you're applying. A natural- or China-bristle brush works well with alkyd (oil) paint but goes limp in water-based paint, making cutting in a clean line impossible. Water-based paints call for a brush with synthetic bristles made of, say, nylon. Once you've got the right paint-brush pairing and you're ready to cut in the line, dip only the bottom inch of the bristles into the paint. Oversaturation with paint makes even the best brush tough to control.

Professional painters can adeptly pull or push a brush and get a razor-sharp line in a corner. Most of us amateurs, though, will probably have better results if we pull the brush toward ourselves, keeping a small bead of paint rolling along the edge of the brush as we move it along the corner.

Floored

I spilled some battery acid on my concrete garage floor, and even though I thoroughly rinsed the area with water, the acid still left some large white spots. How can I restore the floor?

Battery acid is tough stuff, as you've discovered. In this case, it appears to have etched the floor. Given the fact that you've already rinsed the area, you may be able to conceal the blotches by carefully brushing on concrete stain to match the color of the surrounding surface.

If this doesn't give a satisfactory result, stain the entire floor. To do this, first clean the concrete with a degreaser like the one from H&C (hccconcrete.com). Next, dampen the floor and sprinkle on the company's etching solution, scrubbing it in with a stiff broom. Finally, rinse the area; when dry, apply a concrete stain. **PopMech**



GOT A HOME-MAINTENANCE OR REPAIR PROBLEM? ASK ROY ABOUT IT.

Send your questions to pmhomeclinic@hearst.com or to Home Clinic, Popular Mechanics, 300 W. 57th St., New York, NY 10019-5899. While we cannot answer questions individually, problems of general interest will be discussed in the column.

SHARPEN YOUR BITS

**FAST
EASY
WORKS EVERY TIME**

Save Money

- Sharpen what you already own

Durable

- 3 year warranty

Sharpens:

- Carbide, HSS, Cobalt, Titanium bits from 3/32" to 3/4"



WATCH DEMO



Drill Doctor.com
The Drill Bit Sharpener

W

WEEKEND

BIG JOB?

Obviously you're not going to haul the world's largest collection of tools around with you. But when you're faced with a big job, you still have to live with the ride of your truck. It's simple. Just add air to the Firestone Ride-Rite™ air spring suspension. It controls the load, maintains that great ride, and stabilizes the vehicle.

Handle the Extra Burden with the Power of Air.

Firestone Ride-Rite™ Air Helper Spring Systems are available for most Truck, SUV, Mini-Van, CUV and Car applications. Call or visit us online for the dealer nearest you.



Firestone

World's Number 1
Air Spring.



FIRESTONE INDUSTRIAL PRODUCTS COMPANY

1.800.888.0650 • ride-rite.com

Do not exceed the vehicle's Recommended
Gross Vehicle Weight Rating (GVWR)

LASER IT!

Cut it. Engrave it. Mark it.

Start a Laser Engraving, Cutting and Marking Business with an Epilog Laser

From creating and personalizing 3D models, to engraving photos on keychains, to marking auto parts and accessories, our laser systems create the products you see here and more!

Laser Systems Starting at \$7,995

Visit epiloglaser.com/popmech.htm for more information and to receive your brochure kit with engraved and cut samples!



E
EPILOG
LASER

1.888.437.4564
sales@epiloglaser.com

MADE IN USA

diy

Science



BY MADELINE BODIN



FLASH MOB

Fireflies could be slowly flickering out of existence. Serious bug watchers think they've observed a recent decline, but scientists aren't certain—firefly populations go through natural booms and busts. Getting a read on them is difficult, says Don Salvatore, coordinator of the Firefly Watch project at the Museum of Science, Boston. "Fireflies are much more complex than people realize," he says. "It's not like counting birds or flowers or butterflies."

Now, firefly fans across the U.S. can help scientists gather crucial data while spending leisurely evenings in their own backyards. Firefly Watch provides tips for identifying tell-tale flash patterns; in return, volunteers submit weekly observations, plus details about their local landscape. Such information may help scientists tease out the effects of lawn mowing, pesticides, and light pollution (fireflies' flashes, the insect equivalent of a listing on Match.com, can be drowned out by porch lights and streetlights). Sign up to participate, or help interpret the data collected so far, at mos.org/fireflywatch. **PopMech**



Unlike males, female fireflies almost always perch while flashing.

GUIDE: MEET THE BEETLES

There are about 200 species of fireflies, or lightning bugs, in the U.S. The grubs of all species glow, but only adults east of the Rockies flash. Each species has a distinct flash pattern, which speeds up or slows down according to the temperature. Here are seven of the most common.

- 1 **SPECIES:** *Photinus consimilis* [slow pulse] // **GLOW:** yellow-green // **MALE FLASH PATTERN:** Two to three $\frac{1}{4}$ -second flashes every 15 seconds.
- 2 **SPECIES:** *Photinus consimilis* [fast pulse] // **GLOW:** yellow-green // **MALE FLASH PATTERN:** Four to nine flashes every 11 seconds.
- 3 **SPECIES:** *Photinus ignitus* // **GLOW:** yellow-green // **MALE FLASH PATTERN:** A quick $\frac{1}{8}$ -second flash every 5 seconds.
- 4 **SPECIES:** *Photinus consanguineus* // **GLOW:** yellow-green // **MALE FLASH PATTERN:** A double $\frac{1}{4}$ -second flash every 6 seconds.
- 5 **SPECIES:** *Photinus marginellus* // **GLOW:** yellow-green // **MALE FLASH PATTERN:** A $\frac{1}{4}$ -second-long flash every 3 seconds.
- 6 **SPECIES:** *Photinus pyralis* // **GLOW:** yellow-green // **MALE FLASH PATTERN:** A $\frac{1}{2}$ -second-long flash every 6 seconds.
- 7 **SPECIES:** *Pyractomena angulata* // **GLOW:** amber // **MALE FLASH PATTERN:** A rapid flicker every 3.5 seconds.

W

WEEKEND

10 TOP CIGARS + HUMIDOR \$29⁹⁹



(\$155 value)



only
\$29⁹⁹*

Includes **FREE**
glasstop humidor

only
\$29⁹⁹!
(\$155 value)

Top-Shelf Glasstop Humidor Combo

If you like handmade cigars, you're gonna love Cigars International! To prove it, I've compiled a sampler with 10 of the finest cigars in the world plus a **FREE** glasstop humidor for one super-low introductory price: instead of the normal retail of \$155, my offer to you is just \$29⁹⁹! I'm betting once you receive these outstanding cigars, together with our free 92-page cigar catalog, you'll become a lifetime customer. Now that's an offer you can't refuse! *Limited time offer.*

One per customer please.

Includes 1 each of: Torano • Gurkha • CAO • La Gloria Cubana • Cohiba • Macanudo • Punch • Hoyo de Monterrey • Padilla • Garo

(From time to time a substitution may occur based on availability.)

* Send me one each of 10 top brands with FREE Humidor for \$29⁹⁹ + \$4⁹⁵ s/h.
* Pennsylvania residents add 6% tax - remittance of any taxes on orders shipped outside of PA is the responsibility of the purchaser. Offer expires 8-15-12. Must be 21 to order.

Code: SAY112 Item# SP-CA27

Name _____
Address _____
City/State/Zip _____
Daytime Phone () _____
Email _____

Signature _____ Birth Date _____

(I certify that I am 21 yrs or older)

Payment: ☐ Check (³⁴ enclosed) ☐ Visa ☐ MC ☐ Amex ☐ Discover
Card # _____ Exp _____

CIGARS INTERNATIONAL 1911 Spillman Drive, Bethlehem PA 18015

1-888-244-2790 mention code SAY112

www.CigarsIntl.com/SAY112

You must enter complete web address for special offer



diy

Auto

- SEASONAL OIL
- WIND BUFFETING
- ECO TIRES

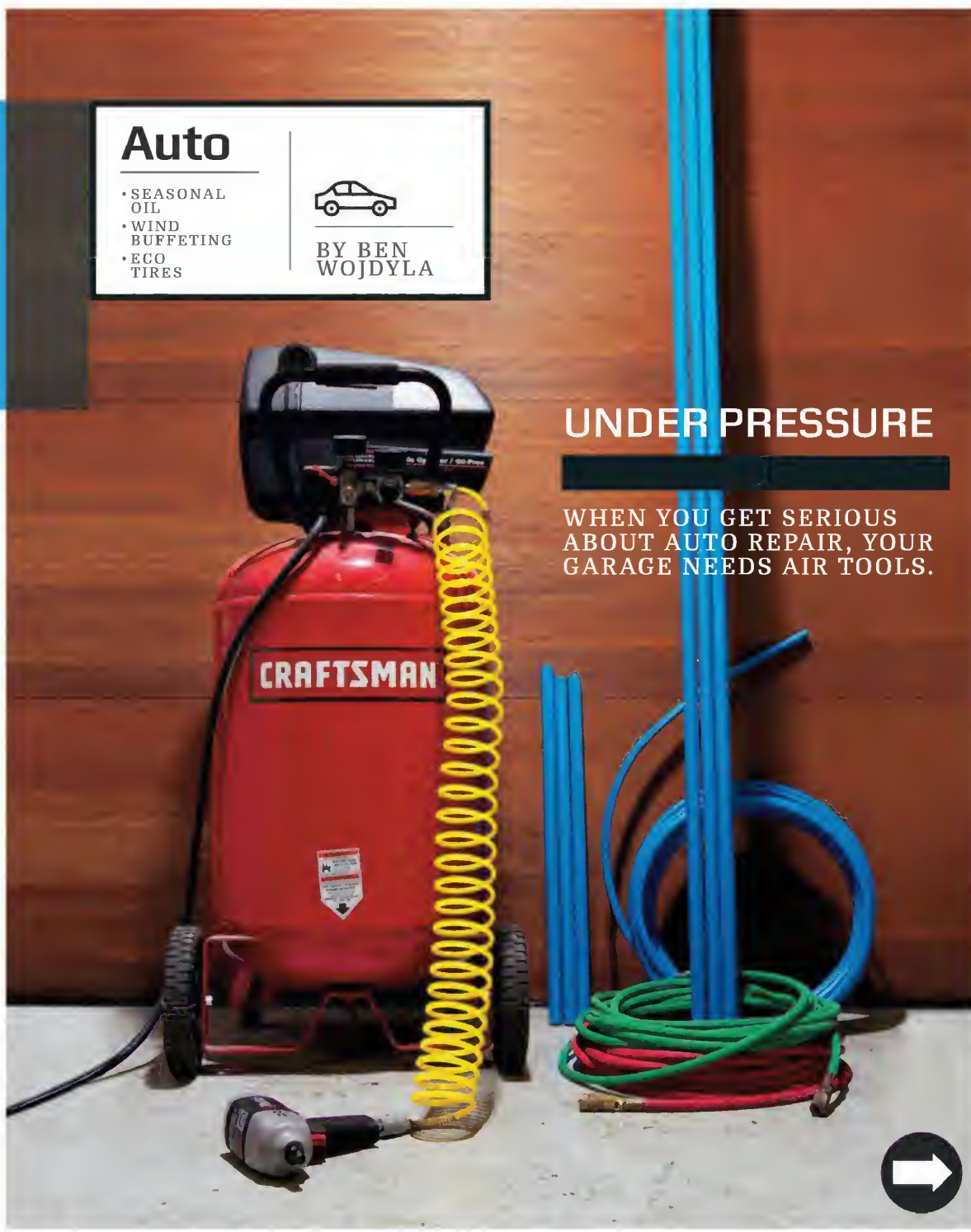


BY BEN WOJDYLA

UNDER PRESSURE

WHEN YOU GET SERIOUS ABOUT AUTO REPAIR, YOUR GARAGE NEEDS AIR TOOLS.

Vertical compressors save floor space and can plumb into a permanent shop air system. Buy the right size unit, though; nothing's worse than a compressor constantly buzzing away while you work.



w

WEEKEND

YOU CAN TELL BY THE EXTENT of a car guy's air system when he's gone from hobbyist to automotive mental patient. For grease monkeys the world over, air tools elicit envy—and for good reason. Their speed and power make car work dramatically easier and put more projects within reach. With a properly sized shop air system, cutting, grinding, polishing, painting, sanding, inflating, and even cleaning up take less time and sweat. Assembling a system for yourself can be a little daunting because there's no shortage of lingo and fiddly components. We've put together a guide to the basics, along with a roundup of the tools we have in our own garage. Be warned, air tools can spoil you.



✓Yes



✓Yes



✓Yes



xNo



✓Yes



✓Yes



✓Yes



✓Yes



✓Yes

- ✓ Everyday Low Prices
- ✓ Easy To Use Website
- ✓ Huge Selection
- ✓ Fast Shipping



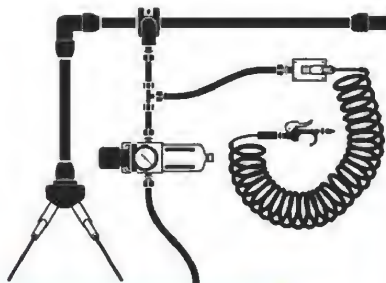
GO TO WWW.ROCKAUTO.COM ROCKAUTO, LLC (EST. 1999)



 DIY AUTO
**AIR COMPRESSOR**

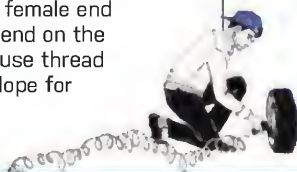
Compressors are sized by SCFM—standard cubic feet per minute—the measure of how much air the machine can deliver when running constantly. An air compressor's SCFM

sets the minimum performance of the system hooked up to it, so look to the consumption rate of the tools you use to decide how to size the compressor. There are two types: Single-stage units are smaller and louder, cycle more often, and are less expensive. Two-stage compressors are quieter, cycle less frequently, and deliver lots of continuous pressure. Pressure tank size is another variable. Bigger tanks hold more air, so the compressor won't kick on as often, but small tanks are portable. For more capacity, connect additional tanks by plugging into a quick-disconnect coupling with a rubber hose.

**PIPES, HOSES, AND FITTINGS**

Design your system of air lines based on budget, garage size, and how often you use your tools. Flexible 3/4-inch rubber air hose is inexpensive and easy to store for the small shop and occasional use. With a bigger garage, consider permanently installed rigid air lines. Options range from simple iron pipe threaded together and sealed, to a slick system from Rapid-Air. The company's modular wall-mounted high-volume hard-pipe or semirigid in-wall kits are assembled by using just a pipe cutter and reamer; if you want, the two systems can be used together.

With all setups, hoses and tools connect via a quick-disconnect coupling. This standardized fitting is threaded onto a hose or pipe end and positively connects the female end on the tool to the male end on the supply side. Be sure to use thread seal tape or plumber's dope for airtight joints.



The End of the Line

The price of air tools varies wildly. Spend more on the tools you use the most, but feel free to shop for discounts on everything else.

[1] INFLATOR AND AIR GAUGE

Price range: \$10 to \$40

- Fill flat tires and never lose the pressure gauge; these flexible fillers make inflation a snap.

[2] DRILL

Price range: \$40 to \$200

- Air drills have the grunt to bore big holes in metal and never overheat or run out of power.

[3] ORBITAL SANDER

Price range: \$30 to \$120

- Air sanders offer more power than electric, a smoother action, and don't fatigue your hands as quickly.

[4] RATCHET

Price range: \$30 to \$150

- Manual ratchets do the job, but these are faster and save time on big projects.

[5] CUTOFF WHEEL

Price range: \$20 to \$80

- It is the must-have tool for fast and dirty metal cutting.

[6] PAINT SPRAYER

Price range: \$60 to \$450

- High-volume, low-pressure paint sprayers deliver great results.

[7] DIE GRINDER

Price range: \$20 to \$120

- These are excellent for cleaning off paint, smoothing pitted rusty areas, and grinding down any metal that's asking for it.

[8] HAMMER/CHISEL

Price range: \$60 to \$450

- Separate stubborn parts with an air hammer—good ones come with many useful ends.

[9] BLOW OFF

Price range: \$2 to \$10

- A valve and nozzle, this tool makes cleaning debris out of hard to reach places a snap; it also makes sweeping a thing of the past.

[10] IMPACT WRENCH

Price range: \$60 to \$450

- The iconic air tool, it develops up to 700 lb-ft of torque, so use it wisely and with a set of high-strength impact sockets.

[11] RECIPROCATING SAW

Price range: \$40 to \$130

- Great for clean cuts in metal, plastic, or wood.

**SEALS CRACKS FASTER THAN
YOU CAN COMPLAIN ABOUT THEM.**

QUIKRETE

WHAT AMERICA'S MADE OF.™

CEMENT & CONCRETE PRODUCTS™



Concrete crack repair is fast and easy with Quikrete. Just go to our website where you'll find how-to videos, project instructions and shopping lists for over 25 repair and construction projects. You'll also get easy instructions as well as a quantity calculator right on our package. When it comes to concrete repair or any other concrete project, Quikrete helps you turn need to do it into easily done.

To see a how-to video on your smartphone, just snap this tag or visit mvideos.quikrete.com/repairingcracks.

Don't have a tag reader? Get one free at get.beetagg.com



**WIN A
JEEP JK**



SWEEPSTAKES

Featured on
TRUCKS!
on SPIKE TV



Grand Prize:

Enter for a chance to WIN a fully outfitted 2008 Wrangler JK, featuring BILSTEIN 5100 Series Shocks and products from AEV, Bushwacker, Dick Cepek, Flowmaster, Hypertech, KC, Mickey Thompson and Warn.

Also WIN an all-expenses paid trip to the exclusive 2012 SEMA Show!

1st Prize: BILSTEIN 5160 Series Shocks
2nd - 5th Prizes: BILSTEIN 5100 Series Shocks



ENTER NOW AT:

www.bilsteinJKsweeps.com

BILSTEIN Shocks can turn any pickup or SUV into a winner. Visit our website to see the full selection of BILSTEIN shocks, or call toll free for the BILSTEIN retailer nearest you.



Find us on Facebook www.facebook.com/bilsteinUS



Bilstein Gas Pressure Shock Absorbers
ThyssenKrupp Bilstein of America
1-800-556-8617 • bilsteinUS.com





Notice to hoarders: You don't need to lug around a case of oil, a bag of sand, or that box of antique tools you got at the garage sale, right? So **[8] EMPTY THE TRUNK**—less weight, better mileage. Pickup

drivers, [9] **REMOVE THE 300-POUND TOOLBOX FROM THE BED** and, while you're at it, [10] **CLOSE THE TAILGATE** to create a drag-reducing air bubble. *MythBusters* increased the overall range of a full tank by 30 miles using this technique; the show also proved that [11] **A RIGHT-TURN-ONLY ROUTE** increases fuel economy by 3 percent, because idling (at stoplights, for instance) wastes fuel. For that same reason, [12] **AVOID TRAFFIC PINCH POINTS**. Driving at speed is more fuel efficient than creeping along in low gear. And if you're not regularly carrying a bike or a kayak on that roof rack, reduce drag by [13] **SLIDING OFF THE CROSSBARS** or at least [14] **SLIDING THE CROSSBARS ALL THE WAY BACK** (making a single wing).

At the pump [15] **AVOID GAS RATED E15**; the "E" is for ethanol, which has about 30 percent less energy than gasoline and kills mpg. (Ethanol-free gas is rare today; you'll probably have to settle for E10.) While at the filling station, [16] **INFLATE YOUR TIRES PROPERLY** and check them for uneven wear, which works against you. Stickier, wider performance tires also increase road friction and sap mileage. So [17] **STEER CLEAR OF TIRES MEANT FOR RACE CARS**, and [18] **SWITCH TO ECO-FOCUSED TIRES**, which reduce rolling resistance. Also, [19] **GET A TUNEUP**; a smooth-running engine is more efficient.

Finally, don't overlook the obvious: Nothing saves gas like not driving at all. [20] **RIDE YOUR BICYCLE** to fetch that quart of milk, especially if the store is just a mile or so away.



JUST ASKING

WHY AREN'T WE ALL USING
ADAPTIVE BRAKE LIGHTS?

In 2002, BMW introduced a controversial redesign of its 7 Series that included one subtle but potentially important innovation—adaptive brake lights. These lights, sometimes called emergency stop signals (ESS), illuminate an extra element during hard braking to, hopefully, add urgency to the warning to cars behind you. BMW now includes these lights on its entire product line, and other manufacturers have experimented with various ESS systems (including ones that blink or get brighter). Doesn't this seem like a technology that, if standardized and made universal, could reduce rear-end collisions as well as the overbraking that leads to accordion traffic? The National Highway Traffic Safety Administration has been studying ESS since 2002 but currently has no official plan for the technology—despite research that suggests some ESS methods could be effective. We think it's time to figure out what works and run with it. — GLENN DERENE

FIX WHAT OTHER GLUES SIMPLY CAN'T.™

If you take the time to fix something, you want it to last. **Amazing Goop** is perfect for repairs because it holds just about anything – wood, metal, ceramic, glass and more.

Amazing Strength
you can count on that
is impact and
vibration resistant,
and waterproof.



www.eclecticproducts.com

MADE in USA
by Eclectic Products

WHICH WOULD YOU
RATHER HAVE UNDER
THE HOOD OF YOUR CAR?



PERFORMANCE AIR INTAKE SYSTEMS

REPLACES THE ENTIRE FACTORY AIRBOX
ASSEMBLY WITH A SINGLE AERODYNAMIC
TUBE AND OVERSIZED AIR FILTER

- ✓ Guaranteed to Increase Horsepower
- ✓ Washable and Never Needs Replacing
- ✓ Easy to Install in 90 Minutes or Less
- ✓ K&N Million Mile Limited Warranty®
- ✓ 100,000 Miles Between Cleanings*

* Under normal highway driving conditions



**57 SERIES INTAKE SYSTEMS
ARE 50-STATE STREET LEGAL**

See knfilters.com for CARB status on each part for a specific vehicle

KNFILTERS.COM/PM

800-871-0560



© 2012 K&N Engineering, Inc.



DIY AUTO

Car Clinic

BY
BEN WOJDYLA

PHOTOGRAPH BY PHILIP FRIEDMAN

Oil for Any Season

Is there really any benefit or downside to using heavier-weight oils in summer months and lighter-weight oils in winter? Some of my older friends swear it's essential to proper maintenance.



A

Oil is subjected to more misinformation, controversy, out-of-date knowledge, and myth than just about any other aspect of car maintenance. Using the right oil is an essential part of keeping your engine healthy, but what does that mean?

Let's tackle the specifics of your question first. It used to be that changing oil weight for summer or winter months was part of proper maintenance. Old conventional oil formulations had only one viscosity, and oil would thin out as it was heated. In winter months this caused starting trouble because the oil would turn to molasses and the pumps couldn't lube the engine properly. To combat this, a lightweight oil such as 10-weight was used for cold weather, so it would flow, while heavier 30- or 40-weight oils were best in summer months to prevent the oil from breaking down in the heat. This problem was solved with multiviscosity oil, oil that flows better when cold, then thickens and protects better when it's hot—the best of both worlds. With an oil like a 10W40 (the W stands for winter), the oil flows similar to a 10-weight in freezing temperatures to minus 30 C and protects like a 40-weight at 100 C. With this innovation in oil performance, changing weights for the season is no longer necessary and may be detrimental. Modern oils are very effective across all temperature ranges, and new

engines are designed and tested to work specifically with only the type of oil listed in your owner's manual. Older cars can use modern oils too, just base the first viscosity on your climate, e.g., 0W for northern Canada, 10W for Florida, and use the original oil spec for the operating weight. Most older cars work fine with 10W30.

While we're on the topic of oil, it's worth taking a moment to demystify synthetic oil. Synthetics are really just natural oil refined to a much higher degree, with more complex additive packages for improving performance in both everyday and extreme conditions.

Many sports cars come filled with synthetic to offer the best possible protection. Ron Sullivan, Pennzoil's technology manager, broke things down for us. "For most applications, stick with the manufacturer's recommended oil. But if you want to better protect your engine over the long term, especially against extreme abuse like towing or constant stop-and-go traffic, synthetic might be for you." According to Sullivan, a high-quality synthetic flows better at all temperatures, which makes cranking easier in the cold and gets lubrication to critical components faster. It also resists high heat much better, something very critical in the latest turbocharged engines. "When you stop these engines, the oil has to resist being baked by the heat in the turbo's oil bearing," Sullivan says, "And synthetics are better at that." These are bold claims and may be worth considering when choosing oil, but we can't remember the last time an engine failed on conventional oil, so going synthetic when you don't have to may be a waste of money. If you abuse your engine, consider synthetics; otherwise follow the manufacturer's suggestion.

Bad Vibrations

I have a problem when opening a window in my SUV while driving. There's a boom, boom sound which affects everyone in the car and it's worse if it's the driver's window. What can be done to eliminate this problem?

What you're experiencing is called buffeting and it's not unique to your SUV. To boil some very complicated physics down as simply as possible, when you open a window you're piercing what's known in aerodynamics as a boundary layer. The air racing past your car is at a lower pressure than the air inside the cabin, so opening a window means the inside air wants to get out; however, the air rushing by outside gets snagged on the edges of the open window and tries to get inside. The cabin air resists this intrusion while the pressure tries to equalize and the two layers of air "bounce" off each other. This turbulence in the boundary layer causes a rumbling sound that can

Don't Be an Idiot



OPEN A HOT RADIATOR CAP

Engines operate at high temperatures, which means their cooling systems must work within this range as well. Only problem is, coolant can boil in that heat, which makes for inefficient thermal exchange. So just as a pressure cooker raises water's boiling point, the cooling circuit is pressurized to do the same. Assuming your engine is working properly, the coolant is under 10 to 15 psi of pressure when hot. Opening the cap to atmospheric pressure causes rapid depressurization of the hot coolant, and that liquid converts to dangerous steam. Cars with overflow tanks keep pressure sequestered with a spring-loaded valve, but it's better to be safe, and let the engine cool before opening the system for service. When in doubt, place a damp towel between your hand and the cap.

SIMONIZ
"THE DETAILER'S CHOICE"

AMERICA'S NO. 1
Scratch
Remover



Available at these fine stores

AutoZone

Walgreens



Target

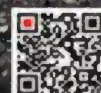


Kmart



O'Reilly

PEPBOYS
AUTO



©2012 Simoniz USA, Inc.

www.simoniz.com



be painful to the ears. The effect of buffeting varies based on the cabin shape and aerodynamics of your vehicle, as well as the speed you're traveling. There's an easy fix, though—give the air inside somewhere else to go. Rather than open just one window, crack open a second or the sunroof so the pressure will be relieved. I've found the opposite-corner window works best.

Put a Ring on It

Recently a tone ring on my 2007 Ford Escape cracked and fell off. The dealer said replacing the entire front halfshaft was the only option. What a waste of a perfectly good shaft! Can I weld the ring and, if so, what can be used to reattach it to the shaft—epoxy?

Tone rings are central to the operation of traction-control systems. For the Escape, they're on the end of the halfshaft that connects the transmission to the wheels, riding on the constant-velocity-joint housing. A tone ring looks like a gear and fits onto or near the hub of each wheel of a car. A sensor sits near the ring and detects the presence or absence of one of those gear teeth. By calculating how fast the teeth are moving, the

car's computer knows how fast each wheel is turning. After comparing the wheel speeds with what it expects to see, the computer decides if any wheels are slipping under acceleration or braking and makes corrections with the brakes and/or the engine output. Because the ring cracked and fell off, the car can't tell what's going on at that corner, leaving the antilock brakes and stability-control systems hobbled. Needless to say, the problem should be fixed.

I know it's tempting to try some hokey fix and glue the ring on again, but trust me, it's not worth the effort. I called some parts stores and found remanufactured Ford Escape front axles cost \$60 to \$70 after a core return. That means you pay about \$150 for the replacement part, but if you take in the old busted part the store issues a partial refund, basically buying the old one from you. Remanufacturers take the damaged parts and tear them down, clean up the main components, then they're rebuilt for future customers. With basic know-how, some simple tools, and maybe a good service manual, changing a halfshaft takes just a few hours in your driveway. You get a good-as-new part, and that otherwise perfectly good axle will see another life. **PopMech**

W

WEEKEND

AutoAnything®

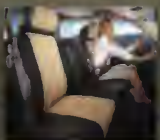


Take 10% OFF
orders of \$150 or more
+ Free Shipping
Use Code PM10
Some Restrictions Apply.

**Boost Your Performance,
Protect Your Investment, Elevate Your Style!**



Custom Mats & Liners



Custom Seat Covers



Air Intakes & Filters



Brake Pads & Rotors



Exhaust Systems



Custom Car Covers



Power Programmers



Nerf Bars



Tonneau Covers



Grille Guards

HYPERTECH

K&N

PROMTEC

HUSKY

FLOWMASTER

WARN

Eastbrook

THULE



Free Shipping
No Hidden Fees



1-Year Price Guarantee
All Prices Backed for a Full Year from Purchase

888.591.8565 | AutoAnything.com



Phone Sales Hours: (PST) Mon-Thur 5:30am-8pm – Fri 5:30am-5pm – Sat-Sun 6am-5pm

Free Shipping to Continental US only. No APO/POs. Truck, oversized & select shipments excluded. Find it for less and we'll refund the difference up to 1 year from purchase. Prices subject to change.



**GOT A CAR PROBLEM?
ASK BEN ABOUT IT.**

Send your questions to pmautoclinic@hearst.com or over Twitter at twitter.com/PopMechAuto or to Car Clinic, Popular Mechanics, 300 W. 57th St., New York, NY 10019-5899. While we can't answer questions individually, problems of general interest will be discussed in the column.

Yokohama's new tire uses oil squeezed from orange peels—we just used orange paint.

PEELING OUT

YOKOHAMA'S NEW AVID ASCEND TIRE USES OIL DERIVED FROM ORANGE PEELS TO ENHANCE TREAD LIFE, GRIP, AND FUEL ECONOMY. BY JAMES TATE

Manufacturing tires has always been a compromise between traction, tread life, and rolling resistance. According to Yokohama engineers, you had to "pick one, blend two, or average three." But those same engineers claim that by replacing some of the petroleum typically used in tires with a bit of oil derived from orange peels, they can mitigate the typical compromises. The result is a low-rolling-resistance tire that can go for more than 50,000 miles yet still effectively grip the road. The company has been very cagey about the details and won't say how much orange oil it uses per tire. As one engineer cryptically put it, the orange oil is "a percentage of a percentage of a percentage" of the tire. In other words, you won't smell

oranges when you do burn-outs in your Nissan Altima. But the Avid Ascend, the new orange oil tire that's available in 45 sizes, includes remarkable treadlife warranties from 65,000 to 85,000 miles. Plus, the company claims a 20 percent reduction in rolling resistance compared with a typical all-season tire. That will save some fuel but probably not enough that you'd notice.

We sampled the tires and found them to be quiet and supple, not at all like the usual stone-hard rolling-resistance tires. We didn't notice any susceptibility to tracking in road ruts, and in the corners there was adequate grip. Our observations are hardly scientific, but we were sufficiently impressed that we'd consider buying these when it's time for new tires. They're slightly more expensive, but with such long tread lives, you should, in the end, come out ahead.

PM ON YOUTUBE The *Car and Driver* channel will host our own *Saturday Mechanic* series with PM's associate auto editor Ben Wojdyla. For a chance to appear on the show, submit your car-related questions to popularmechanics.com/cdchannel.

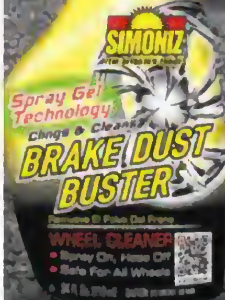


Three Amazing Products

BRILLIANT SHINE... EVERY TIME



CLEANS ON CONTACT



LASTS 30 DAYS

Available at:

AutoZone

SIMONIZ
"THE DETAILER'S CHOICE"



© 2012 Simoniz USA, Inc.

www.simoniz.com

PopularMechanics TAKES YOU...

BACK TO THE FUTURE



1940: The torpedo-like rail car of tomorrow

Over the decades, scientists have peered into their crystal balls, envisioned the world to come...and shared their predictions with readers of POPULAR MECHANICS.

What did they see? Flying ambulances. Space suits made from paper. Utopian cities with elevated sidewalks and sunken streets. Even the cure for the common cold.

In our brand new book—a collection of these speculations with original text by Nebula winner and NASA advisor Gregory Benford—the bizarre, wildly imaginative, and (occasionally) eerily accurate WONDERFUL FUTURE THAT NEVER WAS comes to life.

BOOK JACKET FOLDS OUT INTO A POSTER FEATURING FABULOUS
RETRO ART!



\$24.95 (CAN \$31.95)

AVAILABLE WHEREVER BOOKS ARE SOLD.

◀ 1950: Clean your waterproof home with a hose

HEARST BOOKS

diy

Adventure



BY T. EDWARD NICKENS

○ **ROTATE YOUR CANOE,** so what's normally the stern is up front. Kneel with your butt braced against the bow seat, just behind the center of the boat.

○ **HEEL THE BOAT OVER** by shifting your weight toward the paddling side. [This will shorten the boat's waterline and boost maneuverability.]

○ **USE A J-STROKE** to correct the bow's drift away from the paddle side without killing momentum. Many people J-stroke ineffectively—see the instructions at right.

BOMB-PROOF J-STROKE



1. POWER / Plant the paddle blade in the water with the shaft vertical. Pull the paddle back in a straight line.



2. TRANSITION / As the paddle blade passes your body, twist your hands down and out: The thumb of the top hand points toward the water, and the blade rotates a quarter-turn. It now lies parallel to the direction of travel.



3. CORRECTION / Use your bottom hand to pry the blade away from the boat. Just a few inches of ruddering will tame a bit of bow drift, but more correction will require a hard push. [You're doing it right if your tricep muscle protests.]

4. RETURN / Need a bit more correction? Drag the blade tip through the water for a few inches as you bring the paddle forward.

GOING IT ALONE

PADDLING A CANOE SOLO ISN'T HARD: JUST KNEEL AND HEEL—THEN EMPLOY A ROCK-SOLID STROKE.

P

addling on your own is like having a backstage pass to every overlooked lake cove and river slough. Take your canoe where you want, as fast as you want, without the hassle of coordinating strokes—and schedules—with a partner. Burt Kornegay, who owns Slickrock Expeditions, has guided more than 400 trips, but he still likes going out on his own. "There's a sense of freedom," he says. "You can go at it hard, or snooze all afternoon. And solo paddlers see so much more wildlife because they're quieter." Here's how to transition from two motors to one. **PopMech**

HARBOR FREIGHT TOOLS

Quality Tools at Ridiculously Low Prices

CENTRAL EARTH PNEUMATIC QUAKE

SUPER HIGH TORQUE IMPACT WRENCHES

- Precision machined to master mechanic standards
- Most powerful wrenches in their class
- Variable speed / reversible
- Patented Super Quiet™ technology
- Less vibration and lighter than the competition
- Handle vented to direct exhaust away from user

SUPER COUPON!

Item 90899 shown

ITEM 90899/ 98025/69096



FREE!
WITH MINIMUM PURCHASE OF \$9.99
CENTECH.

7 FUNCTION DIGITAL MULTIMETER
REG. PRICE \$9.99

HARBOR FREIGHT TOOLS - LIMIT 1 Free item only available with qualifying minimum purchase (excluding price of free gift item). Cannot be used with any other discount or coupon. Coupon not valid on prior purchases. Offer good while supplies last. Shipping & Handling charges may apply if free item not picked up in-store. Coupon cannot be bought, sold or transferred. Original coupon must be presented in-store, or with your order form, or entered online in order to receive the offer. Valid through 10/12/12. Limit one coupon per customer and one coupon per day.



SUPER COUPON!

20% OFF

ANY SINGLE ITEM!

HARBOR FREIGHT TOOLS - LIMIT 1 Use this coupon to save 20% on any one single item purchased when you shop at a Harbor Freight Tools store. *Cannot be used with any other discount or coupon. Coupon not valid on any of the following gift cards, Inside Track Club membership, extended service plans, Compressors, Generators, Tool Cabinets, Tool Cars, Welders, Floor Jacks, Campbell Hausfeld products, open box items, Parking Lot Sale items, Blowout Sale items, Day After Thanksgiving Sale items, Tent Sale items, 800 number orders or online orders. Coupon not valid on prior purchases after 30 days from original purchase date with original receipt. Coupon cannot be bought, sold, or transferred. Original coupon must be presented in-store in order to receive the offer. Valid through 10/12/12. Limit one coupon per customer and one coupon per day.



SUPER COUPON!



1/2" PROFESSIONAL AIR IMPACT WRENCH

CENTRAL EARTH PNEUMATIC QUAKE

LOT NO. 68424/2623

700 FT. LBS. MAX. TORQUE

Item 68424 shown

SAVE \$45

\$74.99 REG. PRICE \$119.99

HARBOR FREIGHT TOOLS - LIMIT 4 This valuable coupon is good anywhere you shop Harbor Freight Tools (retail stores, online, or 800 number). Cannot be used with any other discount or coupon. Coupon not valid on prior purchases after 30 days from original purchase date with receipt. Offer good while supplies last. Coupon cannot be bought, sold, or transferred. Original coupon must be presented in-store, or with your order form, or entered online in order to receive the coupon discount. Valid through 10/12/12. Limit one coupon per customer and one coupon per day.



SUPER COUPON!



3/8" PROFESSIONAL AIR IMPACT WRENCH

CENTRAL EARTH PNEUMATIC QUAKE

LOT NO. 68425/92453

300 FT. LBS. MAX. TORQUE

Item 68425 shown

SAVE \$20

\$69.99 REG. PRICE \$89.99

HARBOR FREIGHT TOOLS - LIMIT 4 This valuable coupon is good anywhere you shop Harbor Freight Tools (retail stores, online, or 800 number). Cannot be used with any other discount or coupon. Coupon not valid on prior purchases after 30 days from original purchase date with receipt. Offer good while supplies last. Coupon cannot be bought, sold, or transferred. Original coupon must be presented in-store, or with your order form, or entered online in order to receive the coupon discount. Valid through 10/12/12. Limit one coupon per customer and one coupon per day.



SUPER COUPON!

3/4" PROFESSIONAL AIR IMPACT WRENCH

CENTRAL EARTH PNEUMATIC QUAKE

LOT NO. 68423/92353

1400 FT. LBS. MAX. TORQUE

\$229.99 REG. PRICE \$279.99

HARBOR FREIGHT TOOLS - LIMIT 4 This valuable coupon is good anywhere you shop Harbor Freight Tools (retail stores, online, or 800 number). Cannot be used with any other discount or coupon. Coupon not valid on prior purchases after 30 days from original purchase date with receipt. Offer good while supplies last. Coupon cannot be bought, sold, or transferred. Original coupon must be presented in-store, or with your order form, or entered online in order to receive the coupon discount. Valid through 10/12/12. Limit one coupon per customer and one coupon per day.



SUPER COUPON!



1" PROFESSIONAL AIR IMPACT WRENCH WITH 6" ANVIL

CENTRAL EARTH PNEUMATIC QUAKE

LOT NO. 68429/92421

2000 FT. LBS. MAX. TORQUE

\$259.99 REG. PRICE \$299.99

HARBOR FREIGHT TOOLS - LIMIT 4 This valuable coupon is good anywhere you shop Harbor Freight Tools (retail stores, online, or 800 number). Cannot be used with any other discount or coupon. Coupon not valid on prior purchases after 30 days from original purchase date with receipt. Offer good while supplies last. Coupon cannot be bought, sold, or transferred. Original coupon must be presented in-store, or with your order form, or entered online in order to receive the coupon discount. Valid through 10/12/12. Limit one coupon per customer and one coupon per day.



SUPER COUPON!



3/8" PROFESSIONAL AIR RATCHET WRENCH

CENTRAL EARTH PNEUMATIC QUAKE

LOT NO. 68426/65161

70 FT. LBS. MAX. TORQUE

SAVE \$20

\$69.99 REG. PRICE \$89.99

HARBOR FREIGHT TOOLS - LIMIT 4 This valuable coupon is good anywhere you shop Harbor Freight Tools (retail stores, online, or 800 number). Cannot be used with any other discount or coupon. Coupon not valid on prior purchases after 30 days from original purchase date with receipt. Offer good while supplies last. Coupon cannot be bought, sold, or transferred. Original coupon must be presented in-store, or with your order form, or entered online in order to receive the coupon discount. Valid through 10/12/12. Limit one coupon per customer and one coupon per day.



PITTSBURGH AUTOMOTIVE

HEAVY DUTY RAPID PUMP® FLOOR JACKS

- ALUMINUM RACING JACKS - pit crew quality design, machined from lightweight aircraft aluminum with a sapphire anodized finish
- HEAVY DUTY STEEL JACKS - super tough precision welded construction with industrial grade finish
- Industrial quality for professional mechanics and hardcore automotive enthusiasts
- RAPID PUMP® - exclusive dual parallel pump system lifts with far fewer pumps
- Universal joint release provides precise load control in any handle position
- All jacks meet international quality standards

SUPER COUPON

PITTSBURGH AUTOMOTIVE RAPID PUMP® 1.5 TON ALUMINUM RACING JACK

3-1/2 PUMPS LIFTS MOST VEHICLES!

WEIGHS 27 LBS.

Item 68053 shown

LOT NO. 68053/ 69252

22-13/16" 9-7/16"

SAVE \$60

\$59.99 REG. PRICE \$119.99

HARBOR FREIGHT TOOLS - LIMIT 4 This valuable coupon is good anywhere you shop Harbor Freight Tools (retail stores, online, or 800 number). Cannot be used with any other discount or coupon. Coupon not valid on prior purchases after 30 days from original purchase date with receipt. Offer good while supplies last. Coupon cannot be bought, sold, or transferred. Original coupon must be presented in-store, or with your order form, or entered online in order to receive the coupon discount. Valid through 10/12/12. Limit one coupon per customer and one coupon per day.



SUPER COUPON

PITTSBURGH AUTOMOTIVE RAPID PUMP® 1.5 TON LIGHTWEIGHT ALUMINUM RACING JACK

• Full frame design

WEIGHS 38 LBS.

Item 68054 shown

LOT NO. 68054

27-3/8" 11-7/16"

SAVE \$60

\$109.99 REG. PRICE \$169.99

HARBOR FREIGHT TOOLS - LIMIT 3 This valuable coupon is good anywhere you shop Harbor Freight Tools (retail stores, online, or 800 number). Cannot be used with any other discount or coupon. Coupon not valid on prior purchases after 30 days from original purchase date with receipt. Offer good while supplies last. Coupon cannot be bought, sold, or transferred. Original coupon must be presented in-store, or with your order form, or entered online in order to receive the coupon discount. Valid through 10/12/12. Limit one coupon per customer and one coupon per day.



SUPER COUPON

PITTSBURGH AUTOMOTIVE RAPID PUMP® 2 TON LIGHTWEIGHT ALUMINUM RACING JACK

WEIGHS 43 LBS.

Item 68051 shown

LOT NO. 68051

28-1/2" 12"

SAVE \$70

\$129.99 REG. PRICE \$199.99

HARBOR FREIGHT TOOLS - LIMIT 5 This valuable coupon is good anywhere you shop Harbor Freight Tools (retail stores, online, or 800 number). Cannot be used with any other discount or coupon. Coupon not valid on prior purchases after 30 days from original purchase date with receipt. Offer good while supplies last. Coupon cannot be bought, sold, or transferred. Original coupon must be presented in-store, or with your order form, or entered online in order to receive the coupon discount. Valid through 10/12/12. Limit one coupon per customer and one coupon per day.



PROFESSIONAL QUALITY • INCREDIBLE SELECTION • UNSURPASSED VALUE

US★GENERAL PRO

PROFESSIONAL TOOL STORAGE SOLUTIONS

- Rugged all steel construction with precision welding
- Industrial high gloss powder coat finish
- Heavy duty ball bearings for smooth sliding drawers
- Easy lift spring-loaded latch keeps drawers closed until released
- Industrial casters with rubber tires roll easily with heavy loads
- Lockable drawer with 2 keys



NEW! HIGH GLOSS FINISH!

SIMILAR CABINETS SOLD NATIONWIDE FOR OVER \$5000!

SUPER COUPON!

A. 44", 13 DRAWER ROLLER CABINET
US★GENERAL PRO

Item 68784 shown

LOT NO. 90320/68784
2900 LB. CAPACITY

SAVE \$240

\$359.99

REG. PRICE \$599.99

HARBOR FREIGHT TOOLS - LIMIT 4
This valuable coupon is good anywhere you shop Harbor Freight Tools (retail stores, online, or 800 number). Cannot be used with any other discount or coupon. Coupon not valid on prior purchases after 30 days from original purchase date with receipt. Offer good while supplies last. Coupon cannot be bought, sold, or transferred. Original coupon must be presented in-store, or with your order form, or entered online in order to receive the coupon discount. Valid through 10/12/12. Limit one coupon per customer and one coupon per day.

YOUR CHOICE!

B. 42" SIDE CABINET

LOT NO. 66474/68991 Item 68991 shown
REG. PRICE \$249.99

\$199.99

C. 7 DRAWER END CABINET

LOT NO. 90321/68785 Item 68785 shown
REG. PRICE \$249.99

SAVE \$50

D. TOP CHEST

LOT NO. 92099/68787
REG. PRICE \$349.99

\$299.99

SAVE \$50

Item 68787 shown

SUPER COUPON!

26", 8 DRAWER ROLLER CABINET WITH 8 DRAWER TOP CHEST
US★GENERAL PRO

LOT NO. 67831

830 LB. CAPACITY

SAVE \$70

\$329.99

REG. PRICE \$399.99

HARBOR FREIGHT TOOLS - LIMIT 4
This valuable coupon is good anywhere you shop Harbor Freight Tools (retail stores, online, or 800 number). Cannot be used with any other discount or coupon. Coupon not valid on prior purchases after 30 days from original purchase date with receipt. Offer good while supplies last. Coupon cannot be bought, sold, or transferred. Original coupon must be presented in-store, or with your order form, or entered online in order to receive the coupon discount. Valid through 10/12/12. Limit one coupon per customer and one coupon per day.

SUPER COUPON!

56", 11 DRAWER INDUSTRIAL ROLLER CABINET
US★GENERAL PRO

LOT NO. 67681

3900 LB. CAPACITY

SAVE \$300

\$699.99

REG. PRICE \$999.99

HARBOR FREIGHT TOOLS - LIMIT 4
This valuable coupon is good anywhere you shop Harbor Freight Tools (retail stores, online, or 800 number). Cannot be used with any other discount or coupon. Coupon not valid on prior purchases after 30 days from original purchase date with receipt. Offer good while supplies last. Coupon cannot be bought, sold, or transferred. Original coupon must be presented in-store, or with your order form, or entered online in order to receive the coupon discount. Valid through 10/12/12. Limit one coupon per customer and one coupon per day.

SUPER COUPON!

FIVE DRAWER TOOL CART
US★GENERAL PRO

LOT NO. 95272

700 LB. CAPACITY

SAVE \$130

\$169.99

REG. PRICE \$299.99

HARBOR FREIGHT TOOLS - LIMIT 4
This valuable coupon is good anywhere you shop Harbor Freight Tools (retail stores, online, or 800 number). Cannot be used with any other discount or coupon. Coupon not valid on prior purchases after 30 days from original purchase date with receipt. Offer good while supplies last. Coupon cannot be bought, sold, or transferred. Original coupon must be presented in-store, or with your order form, or entered online in order to receive the coupon discount. Valid through 10/12/12. Limit one coupon per customer and one coupon per day.

400 Stores Nationwide

Order Online at HarborFreight.com and We'll Ship Your Order FedEx®

SUPER COUPON

PITTSBURGH AUTOMOTIVE

RAPID PUMP® 3 TON HEAVY DUTY STEEL FLOOR JACK

Item 68048 shown

WEIGHS 74 LBS.

LOT NO. 68048/69227

SAVE \$70

\$69.99

REG. PRICE \$139.99

HARBOR FREIGHT TOOLS - LIMIT 5
This valuable coupon is good anywhere you shop Harbor Freight Tools (retail stores, online, or 800 number). Cannot be used with any other discount or coupon. Coupon not valid on prior purchases after 30 days from original purchase date with receipt. Offer good while supplies last. Coupon cannot be bought, sold, or transferred. Original coupon must be presented in-store, or with your order form, or entered online in order to receive the coupon discount. Valid through 10/12/12. Limit one coupon per customer and one coupon per day.

SUPER COUPON

PITTSBURGH AUTOMOTIVE

RAPID PUMP® 2.5 TON HEAVY DUTY STEEL FLOOR JACK

• Lifting range from 2-3/4" to 20"

Item 68049 shown

WEIGHS 77 LBS.

LOT NO. 68049

SAVE \$25

\$74.99

REG. PRICE \$99.99

HARBOR FREIGHT TOOLS - LIMIT 4
This valuable coupon is good anywhere you shop Harbor Freight Tools (retail stores, online, or 800 number). Cannot be used with any other discount or coupon. Coupon not valid on prior purchases after 30 days from original purchase date with receipt. Offer good while supplies last. Coupon cannot be bought, sold, or transferred. Original coupon must be presented in-store, or with your order form, or entered online in order to receive the coupon discount. Valid through 10/12/12. Limit one coupon per customer and one coupon per day.

SUPER COUPON

PITTSBURGH AUTOMOTIVE

RAPID PUMP® 2 TON LOW PROFILE LONG REACH HEAVY DUTY STEEL FLOOR JACK

• Lifting range from 2-5/8" to 23-3/4"
• Foot pedal for fast pumping

Item 68050 shown

WEIGHS 102 LBS.

LOT NO. 68050

SAVE \$60

\$99.99

REG. PRICE \$159.99

HARBOR FREIGHT TOOLS - LIMIT 3
This valuable coupon is good anywhere you shop Harbor Freight Tools (retail stores, online, or 800 number). Cannot be used with any other discount or coupon. Coupon not valid on prior purchases after 30 days from original purchase date with receipt. Offer good while supplies last. Coupon cannot be bought, sold, or transferred. Original coupon must be presented in-store, or with your order form, or entered online in order to receive the coupon discount. Valid through 10/12/12. Limit one coupon per customer and one coupon per day.

SUPER COUPON

PITTSBURGH AUTOMOTIVE

RAPID PUMP® 4 TON HEAVY DUTY STEEL FLOOR JACK

Item 68056 shown

WEIGHS 105 LBS.

LOT NO. 68056

SAVE \$50

\$99.99

REG. PRICE \$149.99

HARBOR FREIGHT TOOLS - LIMIT 5
This valuable coupon is good anywhere you shop Harbor Freight Tools (retail stores, online, or 800 number). Cannot be used with any other discount or coupon. Coupon not valid on prior purchases after 30 days from original purchase date with receipt. Offer good while supplies last. Coupon cannot be bought, sold, or transferred. Original coupon must be presented in-store, or with your order form, or entered online in order to receive the coupon discount. Valid through 10/12/12. Limit one coupon per customer and one coupon per day.

diy

Tech

BY
ANTHONY
VERDUCCI

- POWER ADAPTERS
- THOUGHT-INVOKING APPS
- CARPAL TUNNEL WISDOM

FIX IT IN POST

FIVE SOFTWARE STRATEGIES THAT TURN HOME VIDEOS INTO HOME MOVIES.

The past 30 years of video technology have democratized moviemaking—maybe too much. Anyone can now shoot high-definition video on a smartphone and instantly upload it to YouTube for the entire world to see. That type of uncut cinema verité style makes for good cat-playing-piano clips (if there is such a thing), but the videos that are truly important to you deserve more polish.

The best way to get great results in the editing bay is to shoot quality footage in the first place, with a strong sense of the tale you want your video to tell. But it's amazing how a little bit of work in a basic video-editing program can turn some less than perfect clips into a dramatic exercise in visual storytelling.

Resist the impulse toward special effects and other visual tricks—if you don't know how to organize, arrange, and splice your clips into a harmonious narrative, then all that stuff is just decoration on an unbaked cake. Following these simple guidelines will do a lot more for your video.

1

UNRAVEL THE STORY

Most consumer-grade video-editing programs are nonlinear, which means they allow you to grab and manipulate your clips without destroying the original material. Software such as Windows Live Movie Maker and Apple's iMovie and shareware such as

AVS Video Editor use a storyboard that lets you lay out your clips and rearrange them however you like. Most professional moviemakers would start with a script, then storyboard before they shoot anything. But for clips you've already taken, you're going to have to do that process in reverse. Take the clips you want to use and drag them to the board, then rearrange them until you see a story emerge. Don't worry about clips blending together at this point, just look for a rough sense of narrative progress. Consider the mood and pacing of the footage. Is it sports video with lots of movement and action? Are there lots of closeups and dialogue? Has your subject been shot from multiple angles? The longer you want your movie to be, the more variety you should be looking for. If it seems as if something's missing, make notes about additional footage, or B-roll, you can film to fill in the blanks (iMovie has dummy clips called Animatics that you can use as placeholders).

W

WEEKEND

2

TRIM THE FAT

It's good to overshoot when it comes to video. But the more footage you have, the more ruthlessly you have to cut in postproduction. The process of editing is all about being selective and stitching together your best material in a way that tells a story efficiently. In each clip, look for the crux of the action and drop anything that's not pivotal. (Most programs let you trim with a simple select and delete.) As a general rule, try keeping clips under 10 seconds—short shots will give your movie a lot more energy than longer ones. That said, don't cut your clips so short that they become confusing.

3

CLEAN IT UP

It's best to plan your lighting, composition, and camera technique before you shoot, but in case that didn't happen, there's still plenty you can do with software. The capabilities vary from program to program. Windows Live Movie Maker is the least sophisticated, but if you're willing to tinker with third-party filters, you can use the free, linear VirtualDub program to do some basic corrections, then import the clips into WLMM for editing. More sophisticated video suites such as iMovie and AVS offer cropping, color correction, and stabilization, which can compensate for sloppy camera-work. Tinkering with the image can have a downside, however—digital cropping and stabilization can lower resolution. But used judiciously, these tools can help smooth out variation from clip to clip, or turn a bland shot of someone talking into a dramatic closeup.

4

BLEND IT TOGETHER

Frequent cuts and angle shifts make a movie more dynamic, but done wrong, these techniques can be jarring. Knowing how to gracefully move from one shot to another is an art form. Most video editors offer lots of fancy sweeps, mosaic dissolves, and other spinning, flipping novelty transitions, but if you trust your material, keep it simple. Transitions are usually found under a menu or palette (some software labels them effects). Don't use too many kinds of transitions—stick to quick cuts for back-and-forth dialogue, cross-fades for blending clips together, and fades to either black or white for complete scene changes.

5

SMOOTH OUT THE SOUNDTRACK

Unfortunately, the built-in mics on camcorders and smartphones are uniformly awful for recording dialogue. If you were unfortunate enough to capture Bigfoot's first recorded growl in a windy patch of forest, both AVS and iMovie offer tools to remove background noise. But remember, software can't perform miracles, and while it's advisable to tinker with the audio settings to get the best results, too much noodling will cause muffled distortion.

Keep in mind that your audio doesn't always have to be tied to your video. If you've got footage of your daughter telling a hilarious story about the family dog chasing its tail, but it's just a still shot of her talking, split the audio track from the video and splice in a shot of the dog spinning around while she tells the story, then cut back to her giggling hysterically at the end—it makes for a far more interesting effect.

Finally, if your recorded audio is garbage or just irrelevant to the action, drop in some music for a mood-setting soundtrack. Editing together wistful memories of your kid growing up? Dial up the sentiment with some Jack Johnson. Trying to make your hockey team's highlights even more awesome? Lay down a track of AC/DC and match the visual cuts to the rhythm changes. But don't invite the wrath of music industry lawyers—if you're posting to the Web, search for royalty-free music on websites such as freeplaymusic.com.

ADVICE
FROM AN
EXPERT

JOEL NEGRÓN,
film editor on
Sleepy Hollow,
*Transformers: Dark
of the Moon* and
21 Jump Street

... on getting organized

"Go through your video and make a select reel. It doesn't have to make sense, just get your best footage for each section of the story. Some people make multiple select reels for closeups, wide shots, medium shots, or all shots of each actor."

... on adding drama

"When editing, I use music from other movies. You can have a shot of a guy just sitting on a bench, and there's nothing happening, but if the music is telling you to feel sad, then you're going to feel sad, and if the music communicates tension, then you're going to feel tension."

... on filling in the blanks

"If you're editing footage of, say, a football game, and the cameraman filmed a touchdown pass, but missed the ball in the air, then the easiest thing to do is cut to a shot of the crowd, then cut back to the guy running the ball."



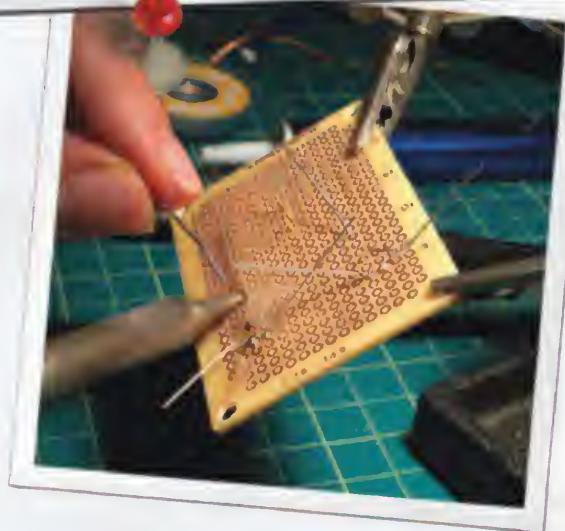
A CELEBRATION OF AMAZING CREATIONS
AND THE PARTS THAT MADE THEM POSSIBLE

OLD SCHOOL TEXT MESSAGING

Build Your Own Telegraph! DIFFICULTY LEVEL: EASY

PARTS

- ☐ 2 - 5x2.5x2" Project Enclosures
- ☐ 2 - Grid-Style PC Board with 371 Holes
- ☐ 2 - SPST Submini Toggle Switches
- ☐ Mini SPST 1.5-Amp Momentary Pushbutton Switch (2-Pack)
- ☐ PC-Board 12VDC 70dB Piezo Buzzer
- ☐ 1/4-Watt Carbon-Film Resistors
- ☐ 75-Ft. UL-Recognized Hookup Wire (22AWG)
- ☐ 75-Ft. UL-Recognized Hookup Wire (20AWG)
- ☐ Assorted LEDs
- ☐ 50-Ft. 4-Conductor Phone Cable

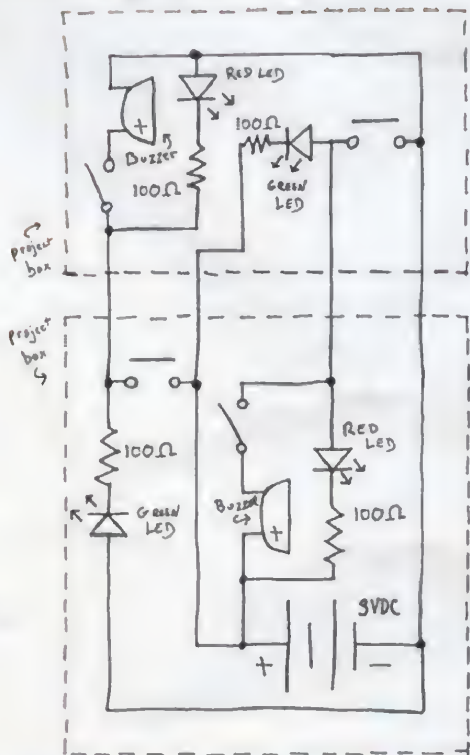


While the thought of tapping out Morse code might seem quaint by today's standards, the electrical telegraph was a revolutionary technology that suddenly made the world a much smaller place. Prior to its widespread use, most communication was limited by how fast a person (or horse) could travel while carrying a letter.

This low-tech project pays homage to the electrical telegraph, and it can be built almost entirely out of basic electrical components available at RadioShack. It uses a fairly simple circuit to send coded "dots" and "dashes" back and forth between two devices that are connected by a length of wire. When you push the transmit button on one of the devices, an LED will blink and a buzzer will sound on the other device. For silent communication, there is a mute switch that turns off the buzzer. (The LED still blinks.)

Each device is built into a project box, and the circuits are slightly different in the two boxes. The battery pack, which powers the entire circuit, is installed in one side. Following the diagram shown here, carefully solder each component onto the circuit board. In the diagram, the dashed-line boxes represent each project box, and the four solid lines between the two dashed-line boxes represent the four-conductor wire running between the project boxes.

Always wear safety glasses. Avoid breathing fumes and always work in a well-ventilated area. Wash hands thoroughly after use. Follow all safety instructions on solder and soldering equipment packaging. California residents: WARNING: Soldering products contain, or when used for soldering and similar applications produce, chemicals known to the state of California to cause cancer and birth defects (or other reproductive harm).



While your Morse code skills might be a bit rusty, with some practice you'll be sending simple coded messages back and forth in no time. And in this age of amazing technology, it's fun to be able to build your own electronic communication device from scratch!

By Ken Murphy

OLD SCHOOL TEXT MESSAGING FEATURES THESE RadioShack PARTS:



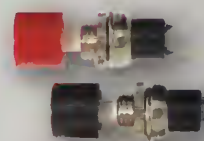
Stranded Hookup Wire



4x100
ohm
Resistors



SPDT Toggle
Switch



Momentary Switches



Grid-Style PC Board



Assorted
LEDs

To see "how-to" video footage for this project and explore other great creations, visit RadioShack.com/DIY.



SCAN THIS QR CODE
TO LEARN MORE





EARLY ADOPTER

Boot-Box Boombox

THREE BROTHERS BLEND OLD-SCHOOL ELECTRONICS SKILLS AND SMARTPHONE TECH TO CREATE A MUSICAL BLAST FROM THE PAST.

DEGREE OF
DIFFICULTY

7/10

AGES: 10+

BUILD TIME:
2 HOURS

PARTS COST:
ABOUT \$50

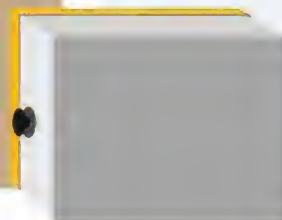


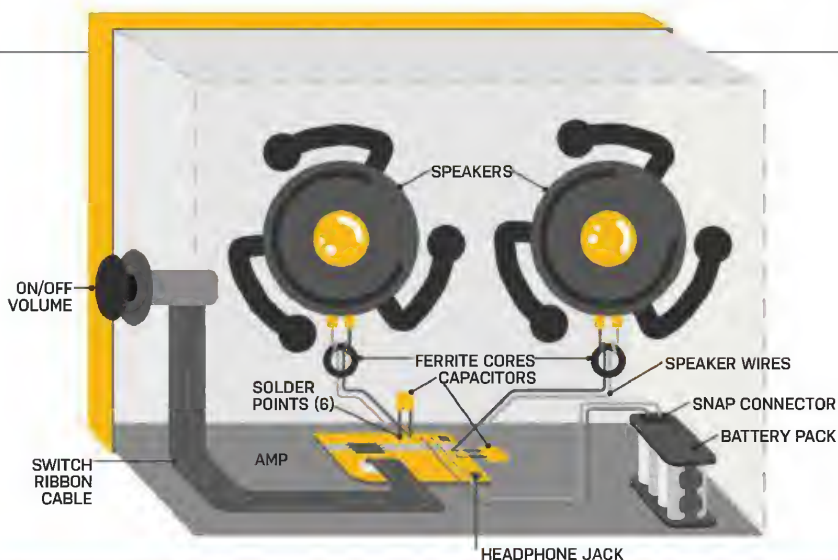
Ethan Donaldson of Cambridge, Mass., shows his soldering skills; he and brothers Seamus and Ben rock on (top).



Tools and Materials

- ▷ 9-volt battery clip
- ▷ 12 VDC 2000mA 2A switching power supply, 2.5-mm plug (optional)
- ▷ 8 AA battery holder; 8 AA batteries
- ▷ 6 feet 3.5-mm male-to-male stereo cable
- ▷ 2 Dayton Audio DAEX25 Sound Exciters (speakers)
- ▷ 1 Dayton Audio DTA-2 Class T Audio Amplifier Module
- ▷ 2 ferrite rings, ½-inch diameter
- ▷ 2 ceramic-disc capacitors
- ▷ Soldering iron
- ▷ Solder
- ▷ Loaded glue gun
- ▷ Boot box
- ▷ Duct tape (optional)





HOW TO BUILD IT

Wire the amplifier

1. Place the amplifier on a work surface, flat side down; position the amp so that the row of four small holes is on the top edge.
2. Strip $\frac{1}{4}$ inch of the ends of the two battery-clip wires; slip the tips of the wires through two of the four holes closer to the amp's right corner, with the black wire in the outermost hole. Bend and then solder the tips to the flat side of the amp.
3. Pair two sets of the red-and-black wires included with the speakers; cut into 15-inch lengths. Strip $\frac{1}{4}$ inch of each wire tip, then loop each pair once around the rim of a ferrite donut.
4. Wrap a tip of one red and one

black wire around the legs of a capacitor. Slip one leg through each of the holes next to those where the battery-clip wires are soldered. The wire colors must alternate: black, red, black, red. Solder the capacitor legs and wires to the amp. (This pair of wires feeds one of the speakers.)

Attach the components inside the box

6. Apply glue to the flat side of the amp assembly, and stick it to the inside of one of the two larger faces of the box. Position the amp so that the switch-ribbon cable reaches the point on the side of the box where you will install the volume-control knob (step 9).
7. Using the self-adhesive tape on each exciter (speaker), affix them to the same face of the box as the amp. Clip the speakers to the two sets of wires attached to the capacitors.
8. Glue the battery pack near a lower corner inside the box. Attach the battery pack to the

amp using the clip.

9. Remove the knob from the volume control (this is also the on/off switch). Poke a hole through a side of the box large enough to fit the stem of the volume control. Place the stem through the hole, reattach the knob, and glue the assembly to the inside of the box.
10. Plug one end of the switch ribbon into the amp and the other end into the volume-control unit. Glue down the ribbon.
11. Plug the ends of the speaker cable into the amp and the device that holds your music library.

Attach your device

12. Turn on your device with the volume on high, choose your favorite playlist, and press play. Close the box—and rock on!

Optional steps

Add a handle made of duct tape; punch a hole in the box through which you can feed a switching power supply wire to the amp.

Pain Relief Without the Pills®



Pills can have dangerous side effects. But with its proven blend of herbal pain relieving ingredients, TIGER BALM delivers fast, safe and effective relief for neck, shoulder and back pain, and muscle aches and strains - without the pills. Available at drugstores, mass merchandisers, supermarkets and health food stores. For more details, visit TigerBalm.com/us.



TIGER BALM®
Works Where It Hurts



Start having fun
all over again!



With just two capsules a day, the compound in Vitali-T-Aid™ combined with exercise substantially increases the body's free testosterone levels, boosting it by a statistically significant amount when compared to exercise and a placebo.

Try Vitali-T-Aid® Today!

- Increases Free Testosterone*
- Boosts Libido & Performance*
- Clinically Tested, Drug-Free*

www.needmore.com

Available at:

CVS/pharmacy Walgreens

*THESE STATEMENTS HAVE NOT BEEN EVALUATED BY THE FOOD AND DRUG ADMINISTRATION. THIS PRODUCT IS NOT INTENDED TO DIAGNOSE, TREAT, CURE OR PREVENT ANY DISEASE.

PHOTOGRAPH BY BEN GOLDSTEIN

DigitalClinic

Power Sharing

I've got both an iPad and an iPhone that share the same connector, but their power adapters have different wattage ratings. I travel a lot and would prefer not to take multiple adapters along. Can I use the higher-wattage adapter on both devices?

Let's start with the official answer: Apple is totally cool with it—the company says so right on the product page for the 10-watt iPad USB power adapter. In fact, Apple lists compatibility with 23 iOS devices dating back to the first-generation iPod Nano. Also, we've tested it—nothing blows up, and the iPad adapter seems to charge the iPhone a bit faster than the stock iPhone charger. So you definitely *can* charge your iPhone with the iPad charger. The more interesting question, however, is *should* you.

All iOS devices (and most smartphones) charge at 5 volts, the standard for USB devices. The difference between the iPhone and iPad adapters is the rated amperage—the iPad charger is rated to handle 2.1 amps, while the iPhone charger is rated for 1 amp. But the amperage

A

W

WEEKEND

Apple iOS devices all use the same 30-pin connector, but the power adapters have different wattages.



STUDIO D

rating is only a measure of the adapter's maximum capability—the actual amperage is determined by the load (i.e., the iPad or iPhone). According to Steve Sandler, founder and chief technical officer of AEI Systems, an electronics analysis company, modern battery-powered electronics have a lot of complexity between the charger and the battery, including battery-charging circuits within the device and battery-protection circuits in the lithium-ion battery itself. These circuits are designed to manage the flow of electricity to the battery, and if the circuits inside the iPhone were designed to tolerate 1 amp, but are routinely exposed to 2 amps, that could stress the system over time. "Even though you may not instantaneously say, 'Wow, I just destroyed my battery!' you may limit its life over the long term," Sandler says, "but you wouldn't know for a year or more." Our advice: Since Apple claims compatibility between the iPad charger and iPhone, pay for the extended two-year warranty for the iPhone to ride out your cell contract, and charge it however you like. If your battery degrades severely after the first year make Apple give you a new one.

Wrists of Fury

I work on a desktop with a mouse and my wrists are killing me. I'm thinking of changing to a laptop. Which is ergonomically better for your wrists, a trackpad or a mouse?

Regardless of whether you're using a mouse or a trackpad, the first thing to consider when alleviating wrist pain is proper ergonomics. In fact, research has shown that products such as padded rests can actually increase the pressure on your wrist. So as motherly as it may sound, correct posture and how you hold your wrist when gripping a mouse or hovering over a trackpad is essential. Make sure your mouse or trackpad is at a comfortable distance (i.e., you're not straining to reach your computer or scrunched in too tight), and keep your wrist straight and off the desk, avoiding jerky motions by using your elbow as the pivot point. With ergonomics out of the way, back to your original question: mouse or trackpad?

Because they allow for more freedom of movement, trackpads are probably the better bet for reducing wrist pain. But Dr. David Rempel, director of the ergonomics training program at the University of California, Berkeley, admits that there hasn't been a definitive study on this topic. His own research on touchscreens, however, suggests touch interfaces are more ergonomically kind, but they're also associated with slower input speeds. Depending on the nature of your work this might not matter. Even if it does

THREE APPS TO ORGANIZE YOUR THOUGHTS



BENTO (\$10)

Like its namesake, this app is all about compartmentalization. Projects, calendars, car maintenance schedules, recipes, and more can be put into templated libraries for maximum organization. Largely text-based, it functions like a personal card catalog of things you need to get done. It's also a great way to handle inventory and expenses for a small business if you use it with the OSX desktop app (which costs an extra \$50). Bento is expensive for an iPad app, but it's still far cheaper than similar apps such as Things (\$20).

NOTABILITY (\$1)

There are plenty of note-taking apps, but Notability is, er, notable for its free-form flexibility. It lets you draw or write on your iPad's screen with a virtual pen in multiple colors (many people choose to use a capacitive stylus for even greater precision). Notability also lets you import photos, diagrams, or Web pages into your virtual notepad and mark them up. Notes can then be exported as PDFs directly to a Dropbox account and automatically synced to multiple computers or shared with friends or co-workers.

PAPER BY 53 (Free, but tools cost \$8)

Born from the ashes of Microsoft's scrapped Courier tablet project, Paper is an example of how restraint can increase the usefulness of an app. Paper's virtual brush-and-pen kit has only six tools and a nine-color palette, and there's no way to drop in photos or zoom in on work. Yet for those who express themselves best visually, Paper can turn a quick sketch into a sophisticated piece of art. Plus, its undo function lets you dial backward in time. This program and a stylus will make an artist out of almost anyone.

slow you down, Rempel suggests forcing yourself to switch occasionally to alleviate repetitive-stress injuries. (The stresses become less repetitive.) You might also try changing mouse/trackpad hands. It will be awkward at first, but spreading the load between hands also reduces pain—and the switch-up will be a good workout for your brain. **PopMech**



GOT A TECHNOLOGY PROBLEM? ASK US ABOUT IT.

Send your questions to pmdigitalclinic@hearst.com. While we can't answer questions individually, problems of general interest will be discussed in the column.

LOOKING DOWNRANGE

CONTINUED FROM PAGE 83

truck then moves. It's a variation on an infantry advance, played out with heavy vehicles, remote-control cameras, and frightened field mice.

Today, the machine guns are left behind as the team practices communication and coordination. A-Team members must be quick learners. The Army's M-ATV official training schedule lasts about two weeks; Alpha's team has only five days. "You'll never catch anyone in special operations saying something can't be done," Alpha says. The next day, they'll mount guns on the CROWS, put a trunk monkey on an M249 squad automatic weapon, and drill on a range with live ammunition.

After the exercise ends, the team clusters on a hilltop to discuss how the bounding overwatch can be improved. In a spec ops A-Team, everyone is free to chime in with critiques. This collaborative atmosphere is a marked difference between conventional and special operations forces. All ranks call each other by first names (Alpha is still "sir").

Leaders ask questions and solicit advice more than they bark orders; mission planning is done with everyone's involvement. The operators contribute critiques but rarely gripe. "It's a team, and so you need to get a consensus," Alpha says. "These are not guys who want to say 'yes, sir, no, sir' blindly."

It's easy to trust the level of dedication of SOF operators—they need direction, not micromanagement. "I was in the [conventional] Army before this, and I worked with a lot of people who didn't want to be there. Everyone here really wants to be here," another junior Echo on the team says. "You feel much better about an operation when you're part of the planning."

SOCOM says the typical operator is 29 years old (officers average 34) and married with at least two kids. This team's stats are skewed by the senior Echo, who has nine children. Team members come from all over the country and represent a dizzying polyethnic mix: Korean American, black Asian, Malay Indonesian. Any demographic differences fade before the bond of their profession. "After this training I'll put

the guys on a four-day weekend," Alpha says. "It won't matter. They're just going to hang out more. This job consumes their lives."

The afternoon is spent towing an M-ATV. Alpha runs the drill as if the team is under attack and needs to get the crippled M-ATV out of the range of enemy weapons (the "kill zone.") Some operators pop out from the rescue vehicle to provide cover with M4 and SCAR-H rifles, while the rest buckle a forearm-thick rope to the "stalled" M-ATV. The engine roars, the two vehicles jolt violently, and the lead M-ATV drags the other to safety.

The drill is a success, but the team runs it again anyway. This time the rope snaps; it may have snagged on metal or simply been used once too often. The severed line whips a bloom of brown dust off the massive spare tire mounted on the M-ATV's rack. "It's not a full day in special operations until we break something," Alpha says. This time the Pentagon got off cheap.

GUERRILLA VS GUERRILLA

In Afghanistan, Alpha's team will try to create a local force, backed by a credible government, to keep the insurgent wolves at bay. "We are trained to be guerrillas," Alpha says. "Who'd be better at being counter-guerrillas?"

The Pentagon calls them force multipliers for a reason. "Every guy is expected to lead one company-size element, up to 100 guys," Alpha says. "I'm supposed to lead a battalion, or 600 guys."

Every member of a 12-man special operations team has made himself into an avatar of the most idealized version of the nation he serves. The pressure is always on to appear perfect in front of conventional and foreign forces. "We always want to build the aura that we are masters of chaos and jacks-of-all-trades," Alpha says. "Expectations are really high. We have to give them what they expect."

The team's Charlie (construction and demolitions specialist) points out that there's a lot of diplomacy involved in being an elite warrior: "I could be talking to a [foreign army] colonel in the morning, the provincial governor in the afternoon." He has no illusions about how hard it will be to operate in Afghanistan. "I could be heading out to the market to



IT STARTS WITH
A WISH
IT CAN END WITH
A CURE

1 in 6 men will be diagnosed with prostate cancer in his lifetime.

When you choose this limited-edition bag, you're supporting vital research to help find a cure. Available at your local Safeway stores during the month of June, while supplies last.

To help The Safeway Foundation and Stand Up To Cancer, and to get the facts about prostate cancer, go to SafewayFoundation.org.

THE
SAFEWAY
FOUNDATION



\$2 from the sale of the \$2.99 reusable bag will benefit prostate cancer research.
Photo by Randall Slavin

Angie Harmon
Stand Up To Cancer
Ambassador

pick up lumber to build a school. Then we're told about an IED [improvised explosive device] and have to go handle it," he says. "Then back to the market, buy the supplies, distribute them, and do the accounting when I get back."

The attacks on Afghans who support the government in Kabul—and the United States—will only grow as 2014 approaches. The police units that spec ops teams train have been the targets of infiltration and murder. "We talk to guys who are over there now," Alpha says. "We're expecting a hard fight."

GOING HOT

With guns mounted on the roof and rear cargo area, the M-ATV is transformed from a truck to a war machine. The A-Team has mounted a .50-caliber machine gun on top of the M-ATV; an Echo seated inside the armored vehicle uses a joystick and the CROWS' video screen to slew the weapon and pick targets.

"Okay, captain, are we going hot?" the gunner asks.

"Yep," Alpha responds from the shotgun side of the front seat.

"Cool."

Alpha scans outside the ballistic glass for cutout wooden targets scattered around the firing range. "Black truck silhouette at two o'clock." The landscape behind the reticule on the CROWS screen swings as the gun mounted on top swivels. "Contact," says the Echo, spotting the target. He presses a red button, bouncing a laser off the target to gauge its distance.

It's taking too long. "Engage targets," Alpha prompts. The .50-cal. thumps and those inside can hear the shattered crystalline sound of 4-inch casings cascading across the hull. Red tracers bounce off rocks and carom 30 feet into the air at crazy angles. The targets are instrumented to fall after a designated number of rounds hit; one by one they drop, ventilated by heavy bullets. "Alpha, this is Zulu," the senior nonenlisted man radios from the other truck, an older RG-33 that has an M240 mounted in its CROWS. "We are moving into position." The RG-33 rolls as the M-ATV provides covering fire. When both trucks are in position, they concentrate their attack on the same targets. The vehicles rattle through hundreds of .50-caliber and 7.62-mm rounds.

The exercise ends and the huddle reconvenes. Details are discussed: advantages of the CROWS' camera stabilization, the importance of the gunner's use of the laser rangefinder to communicate distance to the front-seat spotters, and the best way for the leapfrogging vehicles to communicate.

The sun bows to the horizon, outlining silhouettes of distant, sharp mountain peaks. The team runs the exercise again—and again. "We drill on the basics until we're perfect," Alpha says. "That's what makes us special."

By the time they return from the day's last gun run, darkness has fallen.

Rock-hard pears, a slab of pale turkey, and sickly, over-sweetened yams await them for a dusty dinner at the range. They eat by the light of the M-ATV headlights. After the grim meal, the weapons are dismantled, extra ammo stowed, and worn, wooden DANGER LIVE FIRE warning signs collected from the range. "This is the tempo," Alpha says.

Then it's back to the barracks to clean the weapons. The team won't finish until 1 a.m. Alpha and Zulu will then finish reports and finalize the training schedule for the next day. By the time they lie down in their barracks, PT is only a few hours away. **PopMech**

POPULAR MECHANICS (ISSN 0032-4558) is published monthly, 12 times a year, by Hearst Communications, Inc., 300 West 57th Street, New York, NY 10019 U.S.A. Frank A. Bonnek, Jr., Executive Vice Chairman & Chief Executive Officer; George R. Hearst, Jr., Chairman; Catherine A. Bostron, Secretary; Ronald J. Doerfler, Senior Vice President and Treasurer; Steven R. Swertz, Executive Vice President and Chief Operating Officer; Hearst Magazines Division: David Carey, President; John P. Loughlin, Executive Vice President and General Manager; John A. Rohan, Jr., Senior Vice President, Finance. © 2012 by Hearst Communications, Inc. All rights reserved. **POPULAR MECHANICS** is a registered trademark of Hearst Communications, Inc. Periodicals postage paid at N.Y., N.Y., and additional entry post offices. Canada Post International Publications Mail Product (Canadian distribution) sales agreement no. 40012493. CANADA BN NBR 10221 0943 RT. POSTMASTER: Send address changes to Popular Mechanics, P.O. Box 6000, Harlan, IA 51593. Printed in U.S.A.

EDITORIAL AND ADVERTISING OFFICES:
300 West 57th Street,
New York, NY 10019-3797.

SUBSCRIPTION SERVICES:
POPULAR MECHANICS will, upon receipt of a complete subscription order, undertake fulfillment of that order so as to provide the first copy for delivery by the Postal Service or alternate carrier within 4 to 6 weeks.

>>> Subscription prices: United States and possessions: \$24.00 for one year. Canada and all other countries: \$40.00 for one year.
>>> Should you have any problem with your subscription, please visit

service.popularmechanics.com or write to Customer Service Department, POPULAR MECHANICS, P.O. Box 6000, Harlan, IA 51593. Please enclose your mailing label when writing to us or renewing your subscription.
>>> POPULAR MECHANICS is not responsible for unsolicited manuscripts or art. None will be returned unless accompanied by a self-addressed stamped envelope.

MAILING LISTS:
From time to time we make our subscriber list available to companies who sell goods and services by mail that we believe would interest our readers. If you would rather not receive such mailings,

please send your current mailing label or exact copy to POPULAR MECHANICS, Mail Preference Service, P.O. Box 6000, Harlan, IA 51593.

AS A SERVICE TO READERS,
POPULAR MECHANICS publishes newsworthy products, techniques, and scientific and technological developments. Because of possible variance in the quality and condition of materials and workmanship, POPULAR MECHANICS cannot assume responsibility for proper application of techniques or proper and safe functioning of manufactured products or reader-built projects resulting from information published in this magazine.

Finally, a Tough Super Glue

Gorilla Products Promise:

- Incredible Strength
- Maximum Performance
- The Toughest on Planet Earth®

Welcome to Tough...



www.GorillaTough.com • 1-800-966-3458

Scan for Video





STORAGE WITH STYLE !
Aluminum Garage Cabinets

Toll free
888-343-4463

MODULINE
MODULAR ALUMINUM CABINETS

www.modulinegarage.com



FIVE MINUTE FENCE STAIN
Stain 100 feet of fence in just 5 minutes! Spray: attaches directly to garden hose. No masking, simply hose off over-spray. One quart covers 600 square feet. Select from three natural wood tones; Natura Cedar, Dark Cedar or Redwood.

www.FiveMinuteFence.com

TerraTrike
PART OF THE SOLUTION

World's Most Comfortable Ride

Starting at \$799

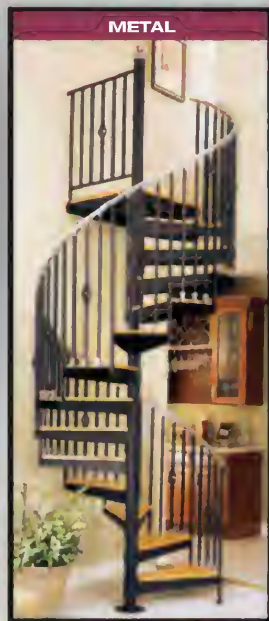
WWW.TERRATRIKE.COM
FREE CATALOG 800-945-9910

Pickup Rear Window Guard Grave Marker

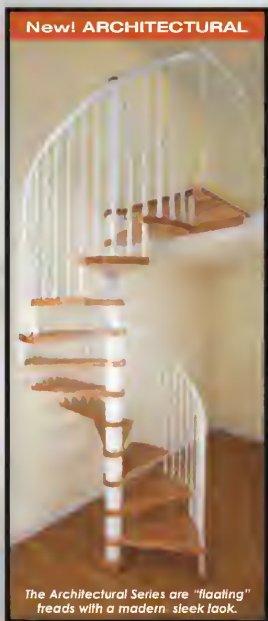
www.art4metalworking.com

Put a spin on your space.

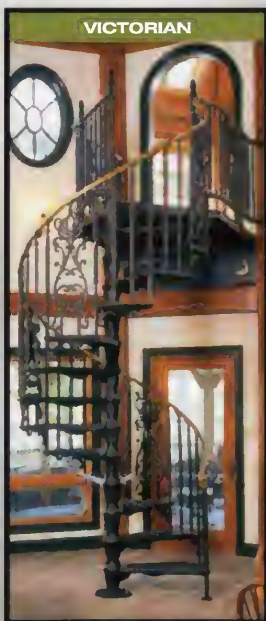
Elegant. Efficient. Affordable.



from \$495



from \$3550



from \$4500

THE IRON SHOP®

The Leading Manufacturer of Spiral Stair Kits®

Proudly made in the U.S.A.

For **FREE** catalog,
call 1-800-523-7427 ext. PM
Or visit www.TheIronShop.com/PM



**TAKE A SEAT
TAKE A STAND**
FOR FORESTS & WILDLIFE

Earthjustice protects our wild places in court—because we believe the earth needs a good lawyer. Show your support for our work by scanning the code and taking a stand for the environment.



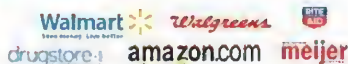
EARTHJUSTICE.ORG/STAND

**For a healthy prostate,
visit your urologist once a
year and take **URINOZINC®**.**



- Formulated to support normal prostate function*
- The only prostate formulation with a US Patent*
- Over 2 Million bottles sold!

Visit urinozinc.com for helpful information on prostate health and to take a FREE Prostate Symptom Assessment.



*These statements have not been evaluated by the Food & Drug Administration. This product is not intended to diagnose, treat, cure or prevent any disease.

A sharp, consistent edge every time!

Standard Sharpening System

Kit includes: Knife handling clamp, oil, guide rods and sharpening hones - all store in the handy carry case.



www.lansky.com

LANSKY
SHARPENERS

Send for your FREE catalog:
Dept. POM, PO Box 800
Buffalo, NY 14231
716-877-7511

"FREE Report Reveals The **ONLY** Way Left For The Little Guy To Get Rich!"

For the first time ever... reclusive million dollar serial entrepreneur is giving away his jealously guarded secrets for quickly making 6-figures (or more!) per year... only working part-time... and living the lifestyle of your dreams. Call NOW!

**FREE 24-hour recorded message:
1-800-261-1994 ext. 1002**

Help them live.



**St. Jude Children's
Research Hospital**

ALSAC • Danny Thomas, Founder

Finding cures. Saving children.

stjude.org

There's a Better Way to Increase Performance



Restore the Power!

- Seals piston rings and valve guides.
- Compression is restored & oil consumption is reduced.
- Restores maximum performance.

AutoZone

O'Reilly AUTO PARTS

**PEPBOYS
AUTO**
Parts, Service and So Much More

**888.275.0015
www.hyperlube.com**

Unclog Drains with Your Pressure Washer

\$10 OFF 100 Ft. Sewer Jetter Only \$129
WEB COUPON PM92

Order Online

ClogHog.com

Or Call 877-992-5644



Not your average
TROPHY CASE.

Whatever your game, display it in a metal building from Heritage. Call us today for a building that will protect and showcase your prized possessions.

**HERITAGE
BUILDING SYSTEMS.**
Established 1979

1.800.643.5555

HeritageBuildings.com



DR® TRIMMER/ MOWER

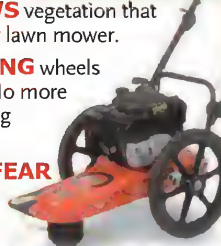
FREE SHIPPING
For a Limited Time

TRIMS AND MOWS vegetation that would stall any ordinary lawn mower.

BIG, EASY ROLLING wheels support the machine. No more back strain from carrying a trimmer!

MOW WITHOUT FEAR

of hitting rocks since there's no blade to bend or dull!



75236X © 2012



Get a FREE DVD and Catalog

TOLL FREE 888-212-8592

www.DRtrimmer.com

To Reach 9 Million 9 Million Prospects each month

or for additional advertising information, call Kathleen Gleason at 708-352-2487, or e-mail: klassmark@aol.com.

THANK YOU for choosing Popular Mechanics Classified Advertising, 512 West Burlington Ave., LaGrange IL 60525.
For subscription questions, visit service.popularmechanics.com.

ALTERNATIVE TRANSPORTATION

Electric and Gas Powered Bicycles,
Bike Conversion Kits, Scooters,
Minibikes, Mopeds, Dirtbikes, ATVs,
WWW.FIVEFLAGSMOTORBIKES.COM
(850) 941-2080.

ARTS, CRAFTS, SUPPLIES

**WHOLESALE PRICES ON
JEWELRY CRAFT ITEMS,**
Beads & Beading Supplies, Rockhound
Supplies, Belt Buckles, Clock
Movements. Free 122 page catalog.
Eloxite: Dept. 45,
Box 729, Wheatland, WY 82201,
Ph.: 307-322-3050
Web: www.eloxite.com

AUTOMOTIVE

AMSOIL, SYNTHETIC LUBRICANTS.
Buy Direct, Register to Buy Wholesale.
Free Catalog. 1-888-450-2658.
www.synthoils.com

BICYCLES

GOLDEN EAGLE BICYCLE ENGINES
2 & 4 Cycle Geared Belt 25 - 40cc
517-410-2793 bikeengines.com

Bicyclist Five FREE
complete videos. For instance:
Fix a bicycle innertube
without a patch, ?
www.youtube.com/royscyclingworld

BOATS, OUTBOARDS, TRAILERS

**BOAT KITS - PLANS - PATTERNS -
SUPPLIES** Catalog \$5.00,
Clarkcraft, 16-6 Aqualane,
Tonawanda, NY 14150.
716-873-2640.

www.clarkcraft.com

AS SEEN ON NCIS!

BUILD YOUR OWN BOAT -
Send \$9.95 for Book of Designs,
includes free plans.
Glen-L, 9152 Rosecrans/PM,
Bellflower, CA 90706,
888-700-5007
WWW.SMALLBOATPLANS4U.COM

BOOKS AND PUBLICATIONS

**IF CHRISTIANS ARE "WRONG"...
THEIR "INVESTMENTS"
ARE SMALL...BUT IF THEY ARE
RIGHT...WHERE WILL "YOU" SPEND
ETERNITY?!? DELIGHT IN BOOKS...
"IN SEARCH OF AN EARTHLY
SANCTUARY WITH FODDER",...
AND "FLOCKS FEED FEAST".
GO TO WWW.AMAZON.COM
TO PURCHASE.**

BUSINESS OPPORTUNITIES

CONCRETE CHARLIE™ Says:
Claim your piece of the \$100 Billion
waterproofing industry and become
a foundation crack repair specialist.
Most Complete Training
in the Industry! Don't Wait!
Territories available NOW!
Or, buy a kit and fix **your** cracks!
www.concretecharlie.com
Enter Pop. Mech Promo Code: 971208

PROCESS MAIL FROM HOME!

Excellent weekly income.
For free information send S.A.S.E.:
Mailers-PM, P.O. Box 458,
New Britain, CT 06050-0458

BECOME A HOME INSPECTOR!

Make \$50,000+ per year.
Free information at
www.HomeInspectionBook.com
FREE ENERGY. FREE INFORMATION.
EnergyIsFree@aol.com

DO-IT-YOURSELF

HYDRAULIC JACK REPAIR

Manual and catalog: \$15.00
620-594-2247,
Hydraulic Parts Supply,
P.O. BOX 97-PM, Sawyer, KS 67134.

ELECTRONICS

CONDUCTIVE PAINT, EPOXY

From \$12. Silver or carbon paint.
Silver epoxy. Carbon tapes.
Custom formulas available.
www.semsupplies.com
301-975-9798 (M-F).

ELECTRONICS

PRINTED CIRCUIT BOARD DESIGN

Schematic, Layout, Packaging,
Fabrication and Assembly. Reverse
Engineering. Prototypes to Produc-
tion. Your one stop solution!
www.PCB3D.com

FINANCIAL

RARE COIN INVESTMENTS.

Our clients **DON'T LOSE** money!
FREE brochure.
DENKO 1-877-777-1754.

FREE

SOON THE GOVERNMENT

will enforce the MARK OF THE BEAST
as CHURCH AND STATE unite!
Let THE BIBLE identify him.
FREE BOOKS/DVDs
The Bible Says, P.O.B. 99,
Lenoir City, TN 37771
thebiblesaystruth@yahoo.com
1-888-211-1715.

HEALTH AND FITNESS

LEGAL STEROIDS -

Build Muscle Fast! Safe & Effective!
1-866-309-4590
www.SWESSPHARMA.com

HEARING AIDS

DIGITAL HEARING AID SALE

16 channel bands, any size, any type
or BTE \$339.95

Options: touchtone, twin mics,
custom molded - \$50.00

New! Open Fit Technology - most brands - big discounts

Repairs \$77.00 (since 1981)

Free brochure & mold kit

Hearing One 1-800-249-4163

100 Main Street, Marty SD 57361

HEARING AIDS - GUARANTEED LOWEST PRICES! No huge

commissions. Home trial, terms.

All makes. We're the oldest,
biggest, best. Custom instrument
specialists. Free information,
1-800-323-4212. Lloyds-PMC

HEARING AIDS

READING GLASSES FOR YOUR EARS

Spice up your marriage,
Laugh with your Grandchildren,
Feel years younger,
Doctor - Designed MDHearingAid
\$169.99 with coupon "PM"
Money Back Guarantee
FREE Brochure - Call/Visit NOW!
www.MDHearingAid.com
800-873-0680

FREE HEARING AID CATALOG!
PRICES START AT \$249.00 !
Lowest Prices ! Huge Discounts !
All Makes ! Trial Period !
Monroe Hearing Aid Corporation
P.O. Box A-3976, Chicago, Illinois
60690 **1-800-462-5778**

INVENTORS

INVENTORS: Free information tells
how to offer your invention
for sale or license.

Kessler Corporation, 52+ years
800-537-1133, ext. 25,
www.kesslercorp.com

PROTECT YOUR IDEA!
Write Your Own Patent
Application
PatentPro® Software
www.patentpro.us

JEWELRY

.....WITH MOTION IN MIND.....
KINEKT DESIGN GEAR RING:

Interactive jewelry for
men & women.
Turn the outer rims of the ring
& see the gears move
(watch our video!).
Lifetime Warranty & Free Shipping.
Order online or call
1-888-600-8494.
www.kinektdesign.com

LAKES & PONDS

LAKE OR POND?

Aeration - 1st Step towards
improved water quality.
Complete Systems \$169 - \$329
11,000 Gal. Per Hour Water
Fall Pump only 3.6 amps! Just
\$399.95 **www.fishpondaerator.com**
608-254-2735 Ext. 3

METALWORKING

BUILD, REPAIR, RESTORE ANY METAL

Quality Hand-tools & Forming
Machines for Automotive,
Aviation, Homeshop, Sculpture,
Instructional DVDs & Workshops.
20 years & still the best!
Free catalog 530-292-3506
www.tinmantech.com

OF INTEREST TO ALL

FREE CATALOG by mail.
Meet nice singles, women, men.
Photos. Profiles. All ages. Since 1981.
Box 310, Allardt, TN 38504
Call 931-879-4625.

OF INTEREST TO MEN

LITEROTICA - Adult Videos,
Pictures & Over 100,000 FREE
Stories! Free Adult Cams!
Personals & Friendship ads!
Over 1,000,000 visitors daily.

WWW.LITEROTICA.COM

MEET SEXY WOMEN

Listen to Ads & Reply..FREE!
FREE Code 7840, 18+
1-888-634-2628

www.MegaMates.com

ASIAN BRIDES! Worldwide!

Free Details/Photos!
PIC, Box 4601-PM, T.O., CA 91362.
805-492-8040.
www.pacisl.com

CHECK UNDER HER HOOD!

Private talk with no limits, 18+.
24/7 - Guaranteed.

ALWAYS WILD,

CC or check

800-605-Chat(2428)

PARTY GIRLS LIVE,
UNCENSORED, ENTHUSIASTIC.

From \$1.65 per min. -
No Connection Fees. **614-263-2633.**

LADIES ARE WAITING!!!

To hear from you...
Beautiful & Exciting
Call Now 1-800-615-6869
V/MC/Amex 18+.

SEXY LOCAL LADIES, WANT
TO HOOK UP NOW!
CALL AND TRY IT FREE!
1-800-996-8444. 18+.

RADIO CONTROLLED

WAREHOUSE HOBBIES

Innovators of gasoline radio
controlled model boats since 1982,
We manufacture ready to run gas
model boats, engines & all components.
Made in USA. Get Your fun on!
www.whobbies.com 1-800-444-1995.

RENEWABLE ENERGY

HIGH QUALITY SOLAR PANEL SALE.

230 Watt - \$345.00 280 Watt -
\$420.00 25 Year Warranty
Dynamo Power Systems
800-230-4016.

SNOW GUARDS

Stop Snow Slides on Metal Roofs!

Practically Invisible, Easy Installation,
Online Estimator.
Fast Shipping **www.snojax.com**

STEEL BUILDINGS

STEEL BUILDINGS, designed for
the do it yourselfer. Buy direct from
the factory & SAVE THOUSANDS.
Worldwide Steel Buildings
www.wsbnw 800-825-0316.

TREASURE FINDERS

BURIED TREASURE - Sensitive
equipment allows locating
from distance. Brochure free.
Simmons, Box 10057-MA,
Wilmington, NC 28404
www.simmonsscintificproducts.com

WANTED TO BUY

BUYING GOLD, SILVER, PLATINUM - ANY FORM

60 years experience.
Free pricing quotes. Top payment.
1-800-932-1010
www.preciousmetalsreclaiming.com

WATER PURIFIERS

DRINKING WATER SCAMS

EXPOSED! Free Special Report
(\$15.00 Value) Find out which water
is best for you! **800-874-9028**
waterwise.com

WINE/BEER MAKING

WINEMAKERS - BEERMAKERS.

Free Catalog. (800)841-7404.
Kraus, 7850-L, Independence,
Missouri 64054.
www.eckraus.com/offers/L.asp

A BRIEF HISTORY OF...

Fireworks

Once just simple incendiary devices, fireworks have become a spectacular staple of celebratory displays. Here's how humanity has lit up the sky through the ages. *BY AMANDA GREEN*

200 B.C.

It starts with a big bang. Bamboo thrown on a fire in China explodes as air expands inside the reeds, and rudimentary firecrackers are born. Locals decide they should be used to scare away evil spirits.

A.D. 600 TO 900

Things get pyrotechnical when a Chinese alchemist combines sulfur, saltpeter, and charcoal and sets it on fire. The more oxygen-rich the saltpeter, the bigger the explosion. Soon the Chinese pack powder, rocks, and metal into containers to make weapons.

1295

Marco Polo brings fireworks to Europe from the Orient. (Also: porcelain, jewels, spices, and other less exciting items that don't go boom.)

1400 TO 1500

The Renaissance begets unparalleled advances in art, literature—and fireworks. The Italians launch projectiles and burn powdered metals and charcoal slowly in open tubes to create sparklers. Controlled fires become de rigueur at coronations. Commoners miss out on the fun.

1635

John Bate publishes the four-part book series *The Mysteries of Nature and Art*. In part two, he outlines how to create flying dragons, along with other fiery spectacles. Among those the book inspires: a young Sir Isaac Newton.

1730s

Powder to the people! In England, fireworks shows become public spectacles for everyone to enjoy. Colonists bring them to the Americas, where they set them off on Independence Day 1777 and think, we should do this again next year.

1830s

Italian pyrotechnicians add color to fireworks with chlorinated powder and metallic salts (strontium = red, barium = green, copper = blue, sodium = yellow). Using potassium chlorate as an oxidizer makes the hues brighter.

1966

Cherry bombs, first used as weapons during the Civil War, are banned in the U.S. But until his death in 1978, Keith Moon, drummer of the Who, blows off steam—and blows up hotel toilets—with illegal cherry bombs.

1976

The U.S. Consumer Product Safety Commission requires fuses on consumer fireworks to burn for at least 3 seconds but no more than 9. Safety warnings on fireworks labels become protocol.

1999

Disney World launches fireworks with compressed air instead of gunpowder at Epcot's pyrotechnic spectacular *IllumiNations: Reflections of Earth*. Disney is the largest U.S. consumer of fireworks, making its theme parks the "happiest places on earth" for American pyromaniacs.

2008

The Chinese Olympic Committee admits that CGI was used to enhance fireworks footprints that appeared to walk across the sky for TV audiences and fans watching the Beijing stadium's Jumbotron. The New York-based Grucci family, who created the actual display, is not amused.

2010

Pop singer Katy Perry releases the empowering single "Firework," reportedly inspired by a passage from Jack Kerouac's 1957 novel *On the Road*.



"THE ONLY PEOPLE FOR ME ARE THE MAD ONES, THE ONES WHO ARE MAD TO LIVE, MAD TO TALK, MAD TO BE SAVED, DESIROUS OF EVERYTHING AT THE SAME TIME, THE ONES WHO . . . BURN, BURN, BURN LIKE FABULOUS YELLOW ROMAN CANDLES EXPLODING LIKE SPIDERS ACROSS THE STARS."





YOU GOTTA LOVE FLANK STEAK

Lean and delicious, with endless possibilities.



If you had a million marinades, you'd have a million reasons to love lean beef, all thanks to the Flank Steak. Get the "Pacific Rim Grilled Steak & Noodle Salad" recipe at BeefItsWhatsForDinner.com.

Funded by The Beef Checkoff



The trend in Internet security has been to innovate as little as possible.

The Edison Awards just recognized Webroot for bucking that trend.

In the last few months, we've replaced slow, bloated security software on hundreds of thousands of home computers and in more than 1,000 businesses – including replacing Symantec at a 28,000-endpoint organization. We also beat Symantec/Norton for PCMag.com's "Best Antivirus of the Year," and our mobile solution was named one of 2011's Top 10 Apps for Android Phones by *The New York Times*.

Welcome to Webroot SecureAnywhere – the most differentiated security solution in more than a decade.



2012 Bronze Award Winner for the best in innovation and excellence for Personal Safety/Security.

2012 Edison Awards
Honoring Innovation and Innovators

Get **THREE MONTHS FREE** when you buy or start your free trial of Webroot SecureAnywhere today. **Hurry - this is a limited time offer.**



For Webroot SecureAnywhere Business, call **1-800-870-8102** and mention SUMMER2012



For Webroot SecureAnywhere home or mobile solutions, visit **webroot.com**



WEBROOT®

SecureAnywhere. — *Business, Home & Mobile*